



Education 4.0 India

INSIGHT REPORT

OCTOBER 2022



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Preface

The Education 4.0 India initiative aims to use Fourth Industrial Revolution technologies to enhance learning and reduce inequalities in India and globally.



Jeremy Jurgens
Managing Director,
World Economic Forum

The COVID-19 pandemic has widened the gaps in learning outcomes among schoolchildren in India. These losses have been particularly magnified for children from disenfranchised and vulnerable families, who face myriad socioeconomic issues that have also been exacerbated during the pandemic. According to a 2021 World Economic Forum paper, *Shaping an Equitable, Inclusive, and Sustainable Recovery: Acting Now for a Better Future*, at least 24 million children, predominantly girls, may never return to school. Urgent action is needed to overcome these learning losses and to scale up solutions that will not only address these gaps but also create sustainable learning environments.

Digital learning can address these challenges effectively and ensure that no one is left behind on the educational journey. To this end, the World Economic Forum has collaborated with

the United Nations Children's Fund (UNICEF) and YuWaah (Generation Unlimited India) to launch the Education 4.0 India initiative.

This report tracks the progress and findings of the Education 4.0 India initiative, which aims to wield technologies of the Fourth Industrial Revolution to enhance learning and reduce inequalities in educational access among children in India. The report takes account of the challenges and identifies the solutions that can be realized as scalable interventions. Its overarching aim is to enable India's youth to participate in the ever-evolving global workspace.

Through the Education 4.0 India initiative, the Forum, together with UNICEF and YuWaah, aims to offer insights and recommendations whose scope transcends the education landscape in India and can achieve global impact.

Foreword



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Founder Chairman and
Board Member, Cyient



Yasumasa Kimura
Representative ad interim,
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the Board, YuWaah



True education must correspond to the surrounding circumstances or it is not a healthy growth.

Mahatma Gandhi

The COVID-19 pandemic exposed the long-existing challenges of the Indian education sector. It widened the gaps in learning for children and educators alike, intensifying the challenge of creating a society where quality education can be accessed easily and by all.

To address the disparities in the Indian education sector and empower India's youth by engaging them as changemakers, the World Economic Forum and the United Nations Children's Fund (UNICEF) have joined forces to create the Education 4.0 India initiative.

The Forum's Centre for the Fourth Industrial Revolution, India, co-designs and pilots projects aimed at facilitating the country's digital transformation. UNICEF, along with YuWaah (Generation Unlimited India), has been expanding education, skill deployment and employment opportunities for the youth. Coming together for the Education 4.0 India initiative, the organizations aim to boost the efforts of the Indian government in education, skilling and employment, and to implement solutions at scale. The partnership drives

a multistakeholder response to identify challenges, opportunities and priorities to develop solutions that can transform India's education sector.

The Education 4.0 India initiative was launched in May 2020, and has convened over 40 partners from the education technology, government, academic and start-up communities. This report is a result of their deliberations and is aimed at building a robust strategy that can be widely implemented, while being cost-effective and sustainable. Under four themes – foundational literacy and numeracy, teacher professional development, school-to-work transition, and connecting the unconnected – the report identifies gaps and outlines interventions, each substantiated by case studies and an implementation roadmap.

This report provides a framework for the development of scalable pilots that can be implemented together with state governments and ecosystem partners, with a view to providing best practices that can augment the existing education ecosystem and be useful for a wide range of stakeholders in the education sector.

Executive summary

The Education 4.0 India initiative suggests action in four focus areas: foundational literacy and numeracy, teachers' professional development, school-to-work transition and connecting the unconnected.

“ Almost 70% of children in grade 3 in India have been reported to have no basic reading and arithmetic skills. Storytelling, read-aloud and interactive content, flip-books and use of digital tools can address these challenges.

Despite significant strides in the field of education, India continues to report poor learning outcomes among schoolchildren. The National Achievement Survey of 2021 found nearly half of primary school students to have learning levels lower than appropriate for their grades, a situation that the pandemic has intensified. This has far-reaching implications for young Indians' readiness for the 21st century workplace and India's preparedness for the Fourth Industrial Revolution.

The Knowledge and Information Network for Digital Learning and Education (KINDLE) is an initiative to utilize digital and other technologies to address learning gaps and make education accessible to all. A joint effort of the World Economic Forum, UNICEF and YuWaah (Generation Unlimited in India), it proposes solutions that align with, and hence augment and amplify, India's National Education Policy (NEP) 2020 and the National Digital Education Architecture of 2021.

Under the KINDLE umbrella, a multistakeholder group of experts in education technology (edtech), representatives of state and central governments, members of non-governmental organizations (NGOs), leading educationalists and path-breaking start-ups studied the existing government and private interventions aimed at improving learning outcomes in schools. They found four areas ripe for innovation in the kindergarten to grade 12 (K-12) space: foundational numeracy and literacy, teacher professional development (TPD), school-to-work transition and connecting the unconnected.

Smaller working groups of experts then studied each of these four themes in depth, in order to zero in on the gaps and suggest specific interventions, whether physical, digital or “phygital”. This report explains these gaps and proposes interventions derived under the guidance of a steering committee so as to be scalable, impactful, cost-effective and sustainable.

A major gap identified in **foundational literacy and numeracy**, for instance, is the lack of “byte-sized” content in early learning that can ignite children's interest, as well as engage parents who may not be educated. Children in grade 3 scored 64.6% in basic language skills and 61.2% in mathematics in the National Achievement Survey 2021. Storytelling, read-aloud and interactive content, flip-books and use of digital tools can address these challenges.

Enhancing teachers' capacity to deliver education in newer formats is a sine qua non, as is their buy-in and involvement in creating and delivering tech-enabled curricula. To this end, the KINDLE approach suggests ways to strengthen **teacher professional development** – for instance by improving the quality of teachers' training, linking training with career progression, and involving teachers in designing a holistic TPD programme.

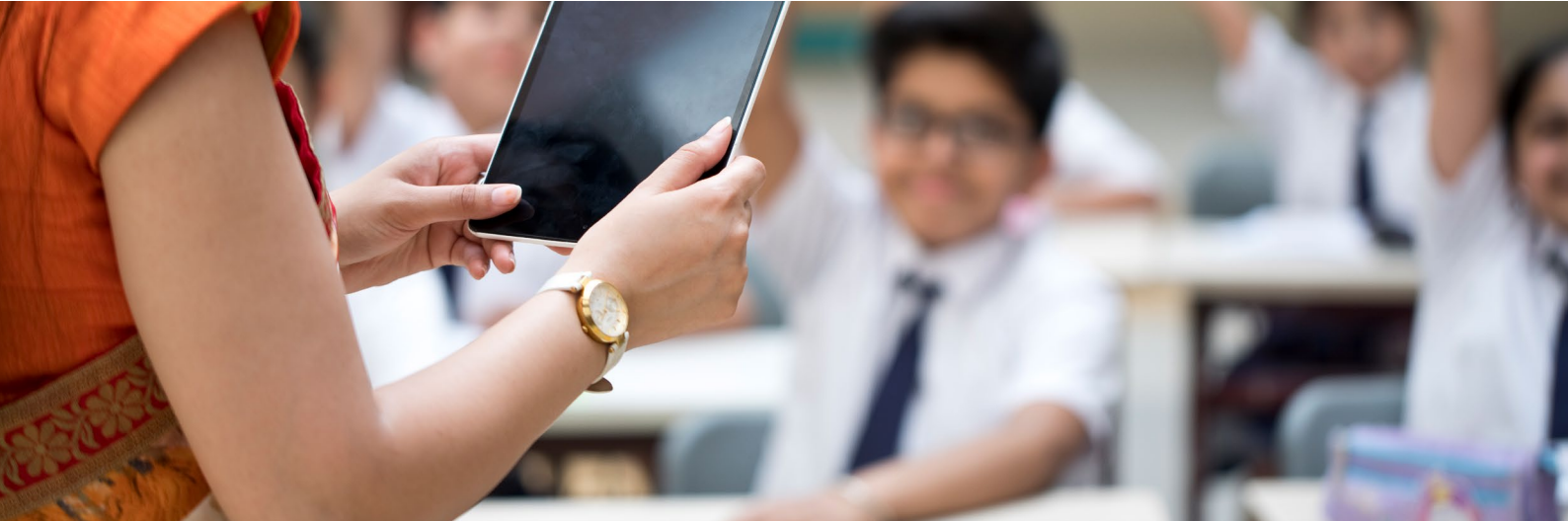
The third priority area, **school-to-work transition**, focuses on making students job-ready in a rapidly evolving employment landscape. Nearly 85% of Indian schools have yet to implement vocational courses as part of their curriculum. This report suggests interventions using digital and hybrid models to upskill students so that they can find a good fit with available and emerging jobs.

The global pandemic has not only made digital learning central to teaching worldwide, it has also widened the digital divide, leaving those without devices and internet connections further behind. For **connecting the unconnected**, this report categorizes schools based on their access to digital infrastructure and suggests interventions to enable schools at each level to get better connected.

The Education 4.0 India initiative builds on efforts by the central and state governments and leverages their interventions. It presents a roadmap to enhance India's school education ecosystem and gives out a call to action to all stakeholders in the edtech space to come together to transform the sector.

Introduction

India can build on the digital solutions tested and adopted during the pandemic to take education to all and prepare Indian school students for success in the 21st century.



India has made significant progress in solving some of the most critical problems in education – it has increased primary school enrolment, reduced the number of children out of school, improved the quality of teaching and increased the number of teachers. However, over the last decade, evidence points to poor learning outcomes among children. The latest results available from the National Achievement Survey of 2021 show an average learning level of 59% in grade 3; 49% in grade 5; 42% in grade 8 and 36% in grade 10.¹ The disparities in education between and within public, private (aided and unaided), urban and rural schools have also remained wide.

These challenges and disparities have been exacerbated by the pandemic, which has disrupted lives all over India, especially of children from marginalized communities. The closure of educational institutions has affected an estimated 286 million children aged three to 18 years.² According to a new report by the World Bank, UNESCO and UNICEF, school closures may have a severe and lasting impact on this generation of students, who may lose the equivalent of 14% of today's global GDP in lifetime earnings.³

One cost-effective way to overcome these challenges is to make quality content accessible to all through the digital medium. The most successful uses of online learning and digital content during the pandemic have demonstrated their power to provide access to the best learning resources

to students based far and wide, in addition to enabling students to study at their own pace and receive personalized content and assessment.

The Indian government has taken several initiatives to make learning accessible for all children. The National Education Policy announced in 2020 (NEP 2020), for example, aims to introduce major educational reforms by ensuring access to quality education for all. During the pandemic-induced school closures, the central Ministry of Education (MoE) and the National Council of Educational Research and Training (NCERT), as well as state governments and union territory (UT) administrations, implemented various programmes to enable remote and home-based learning for children by providing support to teachers, parents and caregivers.

The country has witnessed unprecedented innovations in education delivery through television, radio and online platforms as well as community efforts to ensure that learning does not stop. A greater emphasis on digital solutions can build on these innovations and provide long-term solutions to close the learning gaps and foster skills needed for success in the 21st century. (In educational circles, 21st century skills are understood to include skills such as critical thinking, research, public speaking, teamwork, digital literacy, civic literacy, entrepreneurialism, global awareness, environmental understanding, scientific reasoning and health and wellness literacy.)

1.1 The digital learning landscape

“ The National Digital Educational Architecture launched in July 2021 aims to promote a diverse education ecosystem that is federated, interoperable and ensures the autonomy of all stakeholders.

India has a dynamic education technology landscape, though it faces some significant barriers.

To spread digital literacy⁴ and support the creation of a knowledge-based society, the national government has launched several technology-enabled programmes. These include Digital India, which seeks to make government services available to citizens electronically through improved online infrastructure, expanded internet connectivity, more widespread digital literacy and wider adoption of digital technologies; Skill India, which aims to train hundreds of millions of Indians in job skills, including in the area of digital technologies; and BharatNet, a national optical-fibre network to provide broadband connectivity in rural and interior areas.

Building on the Digital India initiative, the NEP 2020 recommends that a National Educational Technology Forum (NETF) be created to serve as a platform for exchange of ideas and best practices. It would provide direction on the use of technology

to enhance learning, assessment and planning, for both school and higher education. The National Digital Educational Architecture (NDEAR), launched in July 2021, is a unified digital architecture that underpins NEP 2020 by supporting the teaching, learning, planning, governance and administrative activities of schools. Working at the central, state and union territory levels, it aims to promote a diverse education ecosystem that is federated, interoperable and ensures the autonomy of all stakeholders.

Several online education platforms and tools are also available, such as [DIKSHA](#) (digital infrastructure for school education), ePathshala (a portal/app that provides access to educational resources), [SWAYAM](#) (a platform for massive open online courses or MOOCs) and Samagra Shiksha Abhiyan (an overarching programme for schools). Meanwhile, the Padhe Bharat (“India learns”) campaign focuses on improving reading proficiency among children to improve learning.

1.2 Barriers to digital learning

Inequitable access to and use of technology is the main challenge to expanding digital learning and optimizing its potential. Children with disabilities, from migrant families, living in remote areas, from scheduled tribes and scheduled castes, and girls in particular experience these inequalities most acutely. In a rapid assessment of learning in six states, only 68% of adolescents in urban areas were found to use technology-enabled learning tools, and only 47% in rural areas.⁵ Students with disabilities faced unique challenges due to the lack of peer support, lower concentration levels and the need for better parental support.

The COVID-19 pandemic has shone a light on the extent of the digital divide caused by disparate access to and affordability of technology infrastructure (such as internet connectivity and electricity) and devices (such as computers and mobile devices). This divide varies across geographies,⁶ sexes and communities. Only around 41.3% of schools had access to computers and 24.5% to the internet in 2020-2021.⁷ Parents identify access to mobile data, devices and network connectivity as challenges to their children's learning at home.⁸ Multi-modal digital options involving radio, TV and mobile phones can play a pivotal role in narrowing this divide, but are underused.⁹ In addition to technology infrastructure, the inability

of most teachers to use technology effectively to assist their students' learning is a significant barrier.

Further, a gender gap exists in access to and use of mobile phones in India as elsewhere in the world. Women in low- and middle-income countries are 7% less likely than men to own a mobile phone, and 16% less likely to use mobile internet.¹⁰ Such gender gaps are wider in rural areas – in a 2018 report, around one-fifth of women said the internet was not appropriate for them, for cultural reasons.¹¹ As per another research, 12% of women said they did not use the internet because of negative social perceptions associated with its use, and 8% due to lack of acceptance by family members.¹²

Recognizing the huge potential of technology for enhancing learning, as well as the need to reduce inequities in educational access for all girls and boys, the World Economic Forum, UNICEF and YuWaah (Generation Unlimited in India) have constituted a multistakeholder initiative called **KINDLE** – the Knowledge and Information Network for Digital Learning and Education. KINDLE aims to utilize digital and other technologies to address learning gaps and make education accessible to all, with the overarching aim of making Indian students ready for 21st century jobs, and India ready to benefit from the Fourth Industrial Revolution.

Internet users aged 5+

451million

Internet users aged 12+

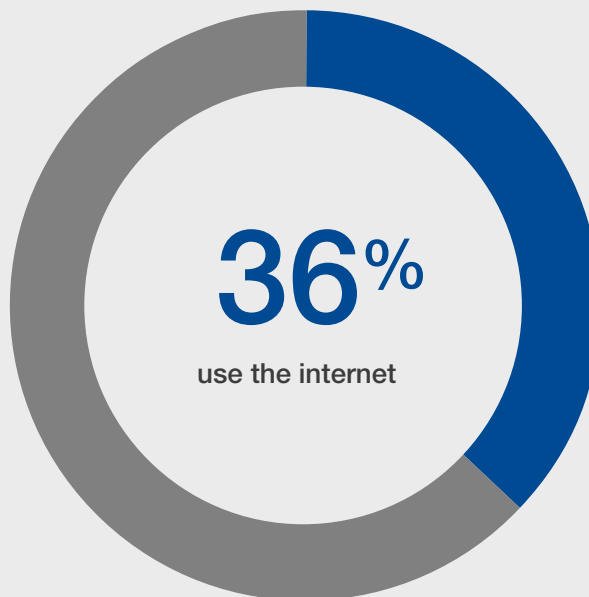
385million

Internet users aged 5-11

66million

*They access the internet on devices
that their family members own.*

Internet usage



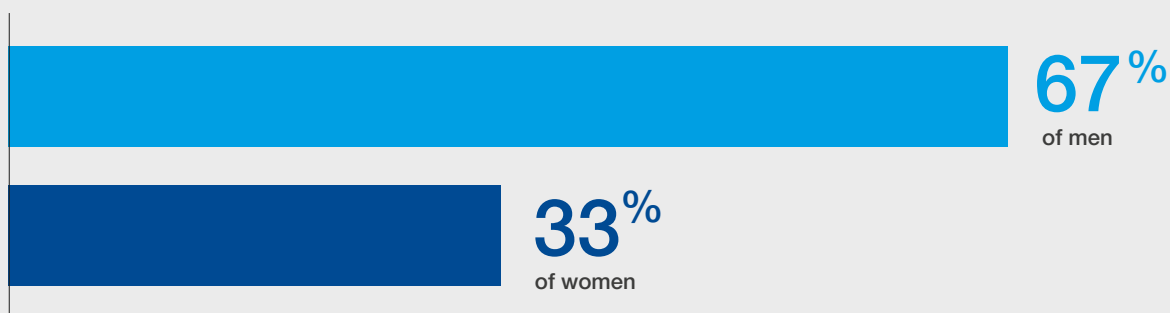
51%

use the internet in
urban areas

27%

use the internet in
rural areas

Internet by gender



Source: India Internet, 2019, Internet and Mobile Association of India (IAMAI).

1.3 The opportunity

The fourth Sustainable Development Goal that countries are striving to achieve under the aegis of the United Nations seeks to ensure equity, quality and efficiency in education. This entails equal learning opportunities throughout life, with up-to-date learning and skilling so that children can transition smoothly into the world of work and participate fully in social and civic life. Education technologies, when adopted appropriately and optimally, can “strengthen education systems, knowledge dissemination,

information access, quality and effective learning, and more effective service provision”, as per the Education 2030 Framework for Action.¹³

India's NEP 2020 aims to improve the delivery of quality education for all learners, including through digital means. From revamping the educational structure to creating a robust digital learning system, the NEP 2020 is aligned with the goals of 21st century education and emphasizes the development of the creative potential of each child.



1.4 The KINDLE approach

Given the urgency of overcoming the learning loss due to the pandemic, the KINDLE community convened a multistakeholder group to identify the key areas of schooling that could benefit from using digital technologies. This group studied the existing government interventions and private solutions in order to find innovative ways to solve key issues at scale.

From May 2021, representatives of the edtech industry, state and central governments, NGOs, the education sector and start-ups met over 16 weeks to identify the challenges and opportunities for digital learning. They focused on the following key themes in the K-12 space:

1. Foundational literacy and numeracy (FLN)
2. Teachers' capacity building (through teacher professional development, or TPD)

3. School-to-work transition (S2W transition)

4. Connecting the unconnected

A working group was assigned to each priority area. After conducting a gap analysis to identify areas ripe for action, and viewing presentations made by promising start-ups, the working groups identified sets of interventions that would enable the key stakeholders to implement scalable solutions.

This report explains the priorities and makes recommendations on scalable interventions in each of the identified themes. It touches upon the design of large, scalable pilots to be taken up in association with state governments and ecosystem partners.

2

Foundational literacy and numeracy

Context-specific, bite-sized content that can be disseminated in print and digital formats can impart the basic skills that are essential for learning as well as personal wellbeing.



“ The NIPUN Bharat programme of the Ministry of Education aims to improve students’ proficiency in reading, comprehension and numeracy.

As per the National Education Policy 2020, the Indian school education system must universalize foundational literacy and numeracy (FLN) skills within the next five years.¹⁴ For this, the system must overcome numerous challenges: performance assessments and competency frameworks must be standardized; training programmes for teachers must teach practical classroom strategies; the curricula used in various states must be context-specific, and so on.¹⁵ The extent of these challenges is evident from India’s low learning levels -- 70% of children in grade 3 do not have basic reading and arithmetic skills.¹⁶

Early literacy and numeracy skills not only impact foundational learning but are correlated with “greater

quality of life and personal well-being and are critical for educational outcomes in the later years”.¹⁷

Over the last few years, several policy initiatives have attempted to use technology to eliminate hurdles in childhood learning. The NIPUN Bharat programme of the Ministry of Education aims to improve students’ proficiency in reading, comprehension and numeracy, to which end it uses digital means and the DIKSHA platform. The DIKSHA portal is integrating the new digital and hybrid curriculum, while the DIKSHA app provides parents and children aged 3-8 years with access to teaching and learning materials such as videos and QR (quick response)-coded teaching and learning aids.

2.1 Current challenges

Data suggests that the FLN challenge is more severe in rural areas. As per the Annual Status of Education Report (ASER) 2018, of the more than 1 lakh (100,000) children aged 3 to 5 years in the sample, only 27.2% of children in grade 3 could read a grade 2-level text, and only 28.1% of grade 3 students could carry out subtraction.¹⁸ Improving

FLN needs better quality teaching content (in local languages), improved engagement and literacy levels among parents, and mechanisms for monitoring children’s progress. These challenges have been aggravated by COVID-19. Table 1 depicts the challenges that the KINDLE working group has identified, in order to prioritize action.

TABLE 1 Foundational literacy and numeracy: Challenges and potential actions

Challenges	Priority areas identified
Creating content: – for the specially-abled and the marginalized – in diverse languages and for different contexts – in different formats such as print, digital, phygital, audio, video, simulations – for young children, in short, digestible, digital formats – in the form of affordable and quality printable materials/kits	Creation of content relevant for specific contexts, which is brief and digestible and can be disseminated in the print and digital formats
Creating capacity to provide foundational literacy and numeracy (FLN) training to Anganwadi workers, parents and caregivers	Design of mechanisms to develop context-specific home-learning environments through multi-modal access to teaching/learning material and capacity building of parents
Enhancing parents’ role in creating a conducive home-learning environment	
Creating a shared vision for FLN and demarcating the roles of various stakeholders	
Communicating data effectively at all levels	Development of formative, child-centric assessments and tracking of results to detect progress across levels
Tracking student progress: – through comprehensive use of technology – by identifying the right metrics for FLN assessments – with assessments that are formative in nature – with assessments that are sensitive to diverse learning styles of young children	
Increasing the focus on education at Anganwadi centres	<i>A new study could shed light on the way ahead</i>
Ensuring collaboration between the ministries of education and women and child development	



2.2 Overview of gaps

“Content that draws upon students’ diverse skills, experiences, abilities, interests and cultures, and integrates these into early learning processes, leads to better understanding and FLN outcomes.

Through a viability and feasibility analysis, the working group has identified three gaps as the most critical to making an impact on India’s FLN landscape. These gaps have been prioritized for action after multiple deliberations within the working group, learning from existing implementation models and consultations with FLN service providers.

Gap 1: Lack of mechanisms to develop context-specific home-learning environments

Home learning is an integral part of a child’s education and parents play a key role in creating an enabling environment at home, where a child spends the maximum time. However, parents’ literacy levels are often inadequate, and parents spend little time at home in situations where both parents go out to work for a living. Hence, solutions that require minimal parental effort are important to facilitate home learning. Access to these solutions could be enhanced if delivered using a range of media including print, digital, phygital, television, radio and telephone. At the same time, parents’ capacity building needs attention.

Gap 2: Lack of context-specific, bite-sized content that can be disseminated in print and digital formats

The earliest learning starts in the mother tongue, which also engages parents who may not be highly educated. Content that draws upon students’ diverse skills, experiences, abilities, interests and cultures, and integrates these into early learning processes, leads to better understanding and FLN outcomes. Further, to sustain a young child’s interest and attention, “byte-sized” digital content is most suitable.

Gap 3: Lack of formative child-based assessments and tracking of results

Formative assessment allows teachers, parents and students to teach and learn while receiving continuous feedback on individual students’ learning. For example, “smart” progress reports improve visibility at all levels and give ample time to take corrective action by everyone concerned, making learning more meaningful.

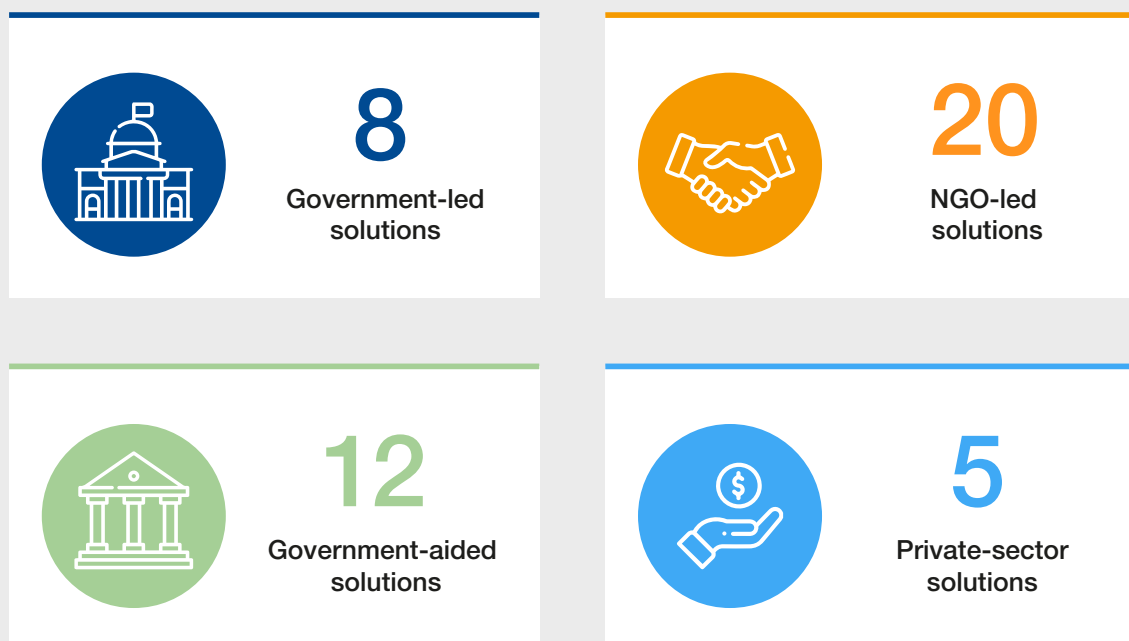


2.3 Proposed solutions

Over the last few years, many initiatives by NGOs, start-ups, corporations and government missions have targeted foundational learning. The working

groups studied 45 such FLN initiatives and analysed them using data collected from both secondary sources and primary consultations.

FIGURE 2 Summary of 45 solutions



Source: World Economic Forum.

Three criteria were used to shortlist the solutions and identify the game changers in FLN:

1. The capability of the solution to engage the home environment and the relevant actors (parents, caregivers and community).
2. The adaptability of the solution, such that it does not require significant behaviour change on the part of the teachers, parents and facilitators.

3. Whether the solution is multi-modal in nature (hybrid or phygital) so as to reach parents and communities in the remotest and most resource-challenged locations.

The solutions filtered as per these criteria have been mapped to the three identified gaps mentioned in Section 2.1.

TABLE 2

Solutions for gap 1 Creating mechanisms to develop conducive home-learning environments

Solution	Unique features	Technology	Resources required to scale
Personalized homework worksheets	- Parents can use personalized worksheets and videos at home - SMS/phone calls can update parents on children's progress	AI-enabled chatbot with two-way engagement	- Parents' smartphones - Parents' basic literacy skills - Parents' basic technological skills to operate smartphones
Content repository	- Parents and teachers can create digital communities - AI can classify individuals' responses and real-time nudges - Engaging materials can create significant group effects - Social media challenges, influencer role-modelling and group competitions can drive interest and engagement	Enabled by core technology stack, AI-backed platform	- Parents' smartphones - Parents' literacy skills to engage with the content and participate
Platform to facilitate content dissemination through parents	- Video content, homework and quizzes delivered everyday on WhatsApp can drive target-based learning - Videos can enable sensitization and capacity building among parents	Mobile app	- Basic digital devices and parents' digital literacy - Parents' literacy skills to engage with the child on the content
Digital kit-based learning in schools	- WhatsApp groups can share content links with parents and teachers - A device containing all material can also be used via TV sets in schools without internet connectivity - Schools and dashboards can be monitored from school to state level to take evidence and performance-based decisions and action - Digitized and gamified assessments for children, linked to dashboards, can make learning enjoyable	Cloud, chatbots, digital content	- Digital infrastructure such as TV, speakers and smart classrooms - Teachers' capacity to deliver integrated lessons - Effective monitoring and evaluation

Note:

1. "Solution" here refers to the specific initiative(s) that any organization is implementing to address the gap area(s) mentioned in the relevant section.
2. For large-scale implementation, the solution may require additional cross-cutting efforts of training, communication, stakeholder engagement, monitoring systems, etc., which are not captured in this report.

3. The description of a solution in this section is limited to its unique features or differentiators with added technological intervention required to scale.
4. The inclusion of a solution as a case study or a mention of it in any context in this report does not amount to endorsement.

TABLE 2

Solutions for gap 1
Creating mechanisms to develop conducive home-learning environments (continued)

Solution	Unique features	Technology	Resources required to scale
Activity kit with worksheets, books and placards	– Kits include activities and interactive tools that foster literacy and scientific (STEM) skills – Hands-on and minds-on activities help build literacy skills	None	– Printing cost of kits and materials – Contextualization and translation costs
Community of parents	– A “role model” parent can be selected from the community to support a network of more than 50 parents – Capacity can be created on communication, digital media, mobilization and mentoring – Telephone helpline and WhatsApp bot can support parent communities	Platform to seek and provide information to parents	– Payment to role models or mentors
Language toolkit and community classes	– Workbooks and graded reading books can be provided for children at home – Face-to-face community classes of 90 minutes each could be conducted by volunteers for three days each week for a batch of 3-10 children	WhatsApp bot to engage with parents	– Resource cost of volunteers/coaches

CASE STUDY

Saarthi Education

[Saarthi Education](#) has developed and implemented a successful approach that ensures high-quality primary education by involving parents. Saarthi provides at-home counselling to mothers, who are more hands-on in the milieu that the NGO works in, to help them understand their children's learning levels and requirements. A community-based relationship manager coaches the mother to build

her own and her child's self-confidence and self-sufficiency. Data and technology are used to provide learning resources personalized to each child's learning level and context, with algorithms using each child's performance data to calibrate the difficulty level. The extensive curricula include 250 “micro-concept booklets” for arithmetic and 1,400 “e-flybooks” with audio support for English.



TABLE 3

Solutions for gap 2**Providing context-specific, bite-sized content that can be disseminated in print and digital formats**

Solution	Unique features	Technology	Resources required to scale
Storytelling to deliver content	- Fixed characters narrating stories for constant engagement - Focus on children's pre-literacy skills - Stories designed to foster cognitive, physical and socio-emotional growth	Videos disseminated through TV, radio, YouTube, WhatsApp chatbots, smart classrooms	Basic infrastructure and devices at home
Cloud-based platform for content dissemination	- Audio stories through interactive voice response (IVR), read-aloud videos, flip-books, radio and TV episodes, digital library - Questions designed at the end of each session for critical thinking	Cloud-based platform, multi-modal dissemination	Basic infrastructure and devices at home
Android app to facilitate reading	Speech-based reading-tutor app developed in multiple languages to: - assist in and assess reading fluency - provide verbal and visual feedback - aid in pronunciation of words and sentences	Speech recognition technology, interactive user interface	- Smartphones - Parents' basic literacy skills to operate the devices and apps
Online content portal	- State-led initiative with repository of content for all grades and subjects, reaching 1.3 crore (130 million) students and 63,000 schools - Contextualized, bite-sized content created by and for the state's teachers and students	Online portal and app	- ICT infrastructure in schools such as digital labs and smart classrooms - Teachers' capacity to deliver integrated lessons

CASE STUDY

Sampark Smart Shala

[Sampark Foundation](#) runs two initiatives, the Sampark Smart Shala mobile app and Sampark TV. The app offers digitized content based on the state's education curriculum as well as a curriculum designed by Sampark Foundation to build a child's conceptual knowledge. It also offers videos, digital books and kits for upskilling teachers. During the COVID-19 pandemic, the foundation shared links with parents and teachers on WhatsApp groups that delivered content under a Har Ghar Pathshala (every home a school) programme to enable home learning, and won appreciation from the government. The content is focused on the subjects of English, science and mathematics. Sampark TV is a plug-and-play device that contains pre-loaded content to facilitate offline teaching in schools through TV and other screens. The device contains more than 500 videos per subject.

The Sampark initiatives focus on enhancing learning outcomes in government schools and are based on a design thinking approach that makes them easily scalable within and across states. So far, the programme has reached 20 million students in 84,000 schools in six states.

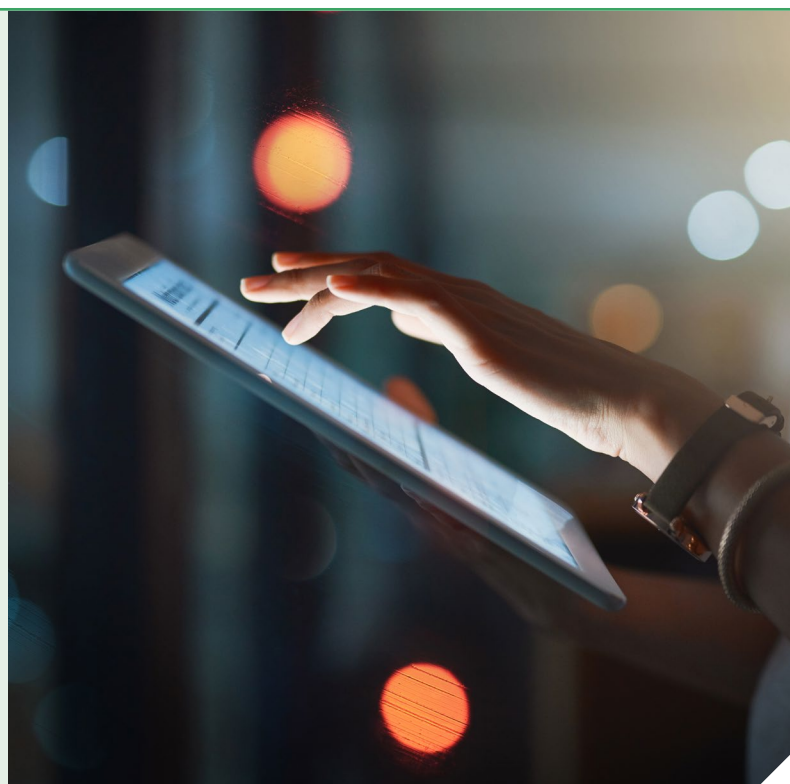




TABLE 4 | Solutions for gap 3
Providing formative, child-based assessments and tracking of results

Solution	Unique features	Technology	Resources required to scale
Artificial intelligence (AI) and machine learning (ML) enabled platform for remediation	- Videos and audio-supported activities on the platform adapt to child's learning pace - Robust data on student's learning level, gaps and progress is captured - Content is broken down into sub-themes to ensure suitable learning from grade to grade	AI-ML, data visualization, predictive analytics	- Internet access - Hardware such as laptop/desktop/tablet, mouse and server - Dedicated resource person(s) to facilitate sessions, resolve doubts, handhold students
AI-enabled app for math learning	- Weekly live classes are provided - Highly engaging activities trigger problem-solving and coding skills - Progress becomes visible and actionable	AI-ML, block-based coding and other programming software	- Basic technology skills - Smartphone or desktop/laptop/tablet
Activity-based learning programme for math education	- Teaching materials such as concept cards, educational kits and abacus are provided to schools to conduct activity-based math skills - Emphasis is on peer learning and learning by doing	Mobile-based app for monitoring by parents	- Teachers' capacity to deliver activity-based learning - Printing cost of materials - Contextualization and translation costs

CASE STUDY | Nanhi Kali



The [Nanhi Kali](#) initiative uses the [MindSpark](#) platform to provide daily academic support to girl students at Nanhi Kali Academic Support Centres established at Anganwadi centres or within government schools for two hours before or after school. The platform provides content assessments for language, math and science, and uses AI-based algorithms to identify learning levels and adapt to each child's pace. It also provides instant and detailed feedback based on a child's specific response and remediates learning gaps. The content for early grades is formative with drag-and-drop activities that children find easy to perform on computers. The initiative has reached 450,000 girl students, with the school dropout rate among its students being less than 10%. The programme has been rolled out in Andhra Pradesh, Delhi, Gujarat, Haryana, Madhya Pradesh, Maharashtra, Punjab, Tamil Nadu, Telangana, Uttar Pradesh and West Bengal.



3

Teachers' capacity building

Teachers' training and professional development are essential to harness their participation in the digital transformation of school education.



3.1 Background

“The long-lasting effects of prolonged school closures and the resultant learning shortfalls can be addressed by supporting communities to tackle children’s learning needs, which enlarges the scope of teachers’ work.

As per the Department of School Education and Literacy of the central Ministry of Education, India has approximately 15.1 lakh (1.51 million) schools, 96.8 lakh (9.68 million) teachers and 26.4 crore (264 million) students.¹⁹ As per the recommendations of NEP 2020, every teacher is expected to undertake at least 50 hours of continuous professional development activities every year, as per their own interests. These activities must “systematically cover the latest pedagogies regarding foundational literacy and numeracy, formative and adaptive assessment of learning outcomes, competency-based learning, and related pedagogies, such as experiential learning, arts-integrated, sports-integrated, and storytelling-based approaches, etc.”²⁰

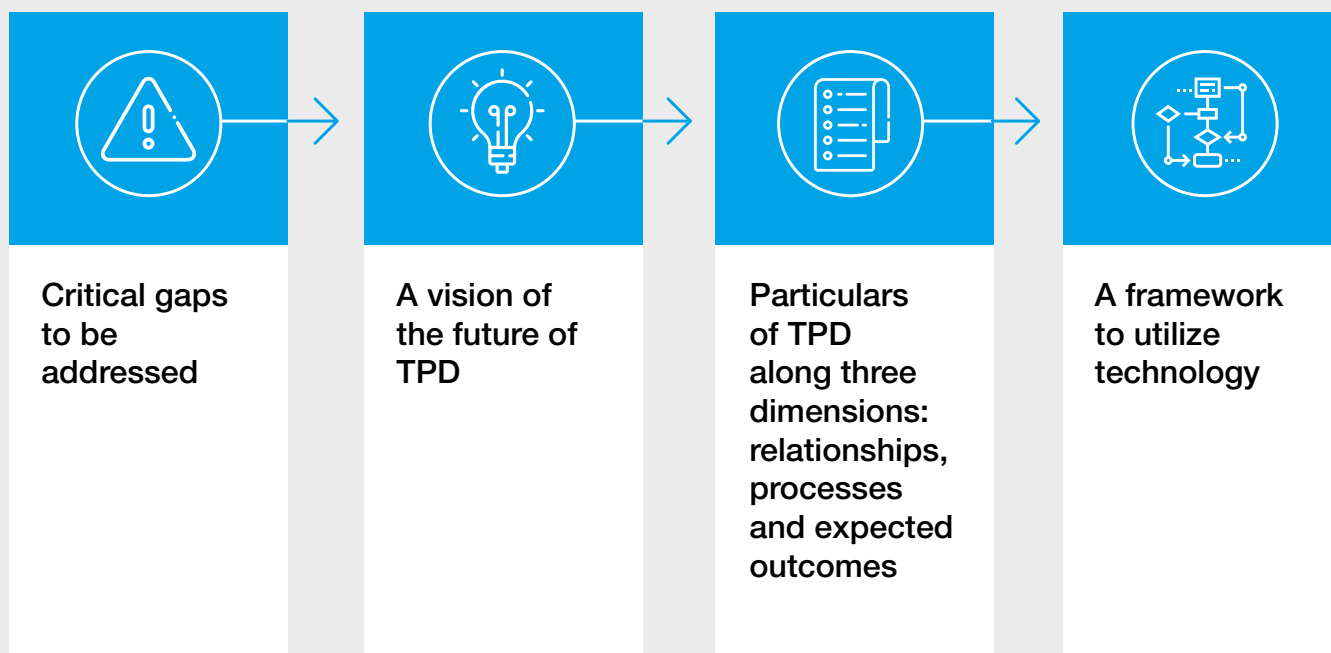
The vision that the NCERT articulated in 2010 to prepare a “professional and humane teacher”²¹ remains relevant today, when the education system is bouncing back from the disruption caused to formal schooling and children’s learning by the COVID-19 pandemic. The loss of loved ones, the uncertainty of parents’ work situations, the need for alternative ways to reach children and their families,

all compelled teachers to use technology to teach differently. The long-lasting effects of prolonged school closures and the resultant learning shortfalls can be addressed by supporting communities to tackle children’s learning needs, which enlarges the scope of teachers’ work.

Teachers’ preparation and participation as partners is essential for effectively translating policy into practice. Teachers are at the frontlines of the evolving classroom. They are called upon to integrate students who speak different languages and come from different backgrounds, and to be sensitive to cultural and gender-related challenges. They are also responsible for equipping students on the use of new technologies and to keep abreast of the rapidly changing fields of knowledge.²²

This makes it imperative to develop policies and programmes to transform the dynamics of teacher professional development (TPD). All aspects of TPD must be “systematically designed and conducted imaginatively”.²³ The following sections look at some critical aspects of TPD.

FIGURE 3 Critical aspects of teacher professional development



“ One aspect that needs more attention is the incentives that teachers have to effect change. Training must be linked with recognition and progression along their career paths.

Over the last few decades, experiential and reflective methods known to work well in enabling TPD have emerged. A systemic approach that views the entire delivery chain holistically is becoming popular, taking in its ambit:

- trainers/facilitators.
- supervisors (including school heads and administrators at cluster and block levels).
- training and administrative bodies (such as the respective District Institute of Education and Training (DIET) and State Council of Educational Research and Training (SCERT)).

The teacher standards delineated in NEP 2020 can be used to design performance assessments for all involved. Establishing which aspects of performance lead to improvement in student learning can help target efforts better.

It is also critical to consider the conditions under which teachers operate and manage change, including their working conditions, autonomy, and academic and professional support. As change processes require a teacher/trainer/supervisor to take risks, a supportive environment is essential.

One aspect that needs more attention is the incentives that teachers have to effect change. Training must be linked with recognition and progression along their career paths.

3.2 Critical gaps in teachers' professional development

The KINDLE working group carried out an in-depth analysis of 10 institutions and programmes to identify what TPDs in India have focused on and what gaps remain to be addressed. No single case study can be said to have been effective, given the long-term nature of TPD and the measurement of its effectiveness. This analysis revealed that:

- Thus far, TPD has focused, in decreasing order of priority, on development, implementation, effectiveness and career progression. On the contrary, all of these must get equal emphasis.

- A system-wide view, in addition to the existing focus on the teacher and at the school level, is necessary.
- While policy and diversity needs have been addressed adequately, the plan for teachers' growth needs more attention.

After examining the case studies to identify the aspects that enhance the viability and effectiveness of TPD, the working group has identified four critical gaps to be addressed on priority.

FIGURE 4 Addressing gaps in teachers' professional development



Development

Assessing teachers' professional development needs against what they are expected to deliver (competency mapping)



Implementation

Strengthening:

- The training of trainers
- The design of curriculum
- Training & monitoring mechanisms for teacher educators, trainers and supervisors



Effectiveness

- Institutionalizing assessment and evaluation of TPD effectiveness (through feedback and assessment related to documented and tangible improvement in classroom processes and students' learning levels)



Career

- Visualizing TPD as progression over a career rather than limited to a "one year" view
- Providing self-paced, blended, anytime-anywhere learning

A detailed approach to addressing all four identified areas is given below.

TABLE 5

Addressing the four gap areas in teachers' professional development

Areas	Critical requirements	Principles, components and practices
Development – Designing a holistic TDP programme	1. Assessing teachers' professional development needs against what they are expected to deliver. 2. Identifying needs from teachers' perspectives and aligning TPD with realities faced on the ground. 3. Ensuring sufficient and timely budgetary allocation in tandem with development programmes in a cascade model. 4. In keeping with NEP 2020, enabling teachers to practice holistic assessments. 5. Developing clear models of experiential pedagogy that teachers can use in the classroom. 6. Ensuring teachers gain experience in what they are expected to deliver in the classroom.	– Principles: Start from where the teachers are and build with them. Teacher needs are linked to system needs. Reach the unreached teachers. – Practices: Start from what is required of the teachers in their current context by analysing what exists and what is missing. Keeping the equity principle at the core, identify a group and design its training. – Components: Teacher resources, individual/group/system needs.
Implementation – Creating training delivery processes	1. Strengthening the training of trainers; designing curriculum, training and monitoring mechanisms for teacher educators, trainers and supervisors; focusing on ways known to ensure quality. 2. Defining the TPD pedagogical model to suit the situation and contexts on the ground (e.g. recurrent, experiential learning linked with supportive supervision). 3. Evolving and implementing clear and practical models of mentoring teachers, providing supportive supervision, and enabling peer-learning networks to ensure sustainability of learning from TPD. 4. Including tech-enabled learning that can help in driving efficiency and effectiveness of trainings as per the digital maturity of teachers (i.e. not a one-size-fits-all model). 5. Designing performance standards for each level (teacher educators, supervisors, teachers) with scope for each to assess themselves and assist their growth. Linking TPD inputs with the levels of performance attained by teachers and others.	– Principles: For ensuring quality of curriculum, training and monitoring: Relationships and processes are critical to attain expected outcomes. For designing curriculum and training: Principles of andragogy – constructivist, practice-based, problem-solving must enable individuals. For designing monitoring mechanisms: Systemic monitoring for enabling support and improvement is needed. – Practices: Phased monitoring for mid-course corrections; mechanisms and tools to enable self-progression through a supportive system. – Components: Manuals, reference materials and performance indicators.
Effectiveness – Measuring how effective training is in improving teachers' classroom performance and practices	1. Institutionalizing assessment and evaluation of TPD effectiveness (assessment that is related to documented and tangible improvement in classroom processes or student learning levels). Currently, TPD programmes are rarely evaluated and are usually not linked to improvement in student learning outcomes. 2. Using real-time/near real-time data (on teacher performance) on an ongoing basis/frequently to align TPD with teacher needs. 3. Factoring in data-mindedness (use of data at various levels) to take decisions when designing TPD.	– Principles: Decentralization of data access and decision-making; course responsiveness to teacher needs; data to inform improvement in the course itself. – Practices: Revamp the content as per the context, in order to align with teacher needs. Use performance indicator data at each level for taking decisions and planning actions. Supervisors/instructors should access and analyse data for taking decisions. – Components: Performance indicators, students' scores, disaggregated data at state, district, block, cluster and classroom level.

TABLE 5 | Addressing the four gap areas in teachers' professional development (continued)

Areas	Critical requirements	Principles, components and practices
Career: Methods to move to a career growth mindset	1. Visualizing TPD as progression over a career rather than limited to a "one-year" view. 2. Identifying connections between teachers' participation and learning in TPD and their career path. 3. Training school administration in how to effectively manage career growth for teachers. 4. Prioritizing teachers' self-motivation for career development (e.g. using an incremental performance scale on which teachers can see themselves improving).	– Principles: Teacher performance is associated with identity recognition – the mental models held about teachers and expectations from them have a bearing on their performance; ensure small wins. – Practices: Articulate the expectations and plan for progression in the system; specify the progression of roles and responsibilities; establish norms for selection rather than nomination.

Case Studies

CASE STUDY 1

Blended course for large-scale TPD – Ignus Pahal and UNICEF, Rajasthan

Overview	
Developed by	Ignus Pahal
Brief description of the innovation	A blended course based on a constructivist design that combines theory with practice. District- and state-level mentors are selected to ensure diversity and to support online TPD. Participation and performance are assessed to provide feedback to participants on their learning and to modify the blended course.
About the initiative	
Region(s)	33 districts of Rajasthan (2019-2020)
Key stakeholders involved	Elementary schoolteachers; teacher educators from Rajasthan State Council of Educational Research & Training, District Institutes of Educational Training; administrators at the state level (Secretary, Education and Director, Education), district level (Chief Development Officer), block level (community-based organization) and panchayat level (Panchayat Elementary Education Officers) supported by UNICEF, online platform manager UniLearn and research partners. 66 state-level mentors, 3,100 district-level mentors and 120,000 elementary schoolteachers of four subjects (science, maths, Hindi and social science).
Actions taken	– Situation analysis, needs analysis, consultations and agreement on technological infrastructure. – Identification and ongoing orientation of state- and district-level mentors. – Course development, implementation and contextualization in consultation with all stakeholders (during course design, piloting, large-scale implementation, coordination among institutions and stakeholders involved, qualitative and quantitative research study, regular review and proactive use of data for modification for adapting the course to teacher needs).
Outcomes achieved	– Development of a conceptual understanding and application of constructivist principles for teaching elementary classes. – Engagement with subject-specific peer learning groups. – Preparation of "participant improvement plans" for implementation in classrooms. – Establishment of principles and strategies for academic and administrative support at all levels. – Decentralization of decision-making at the block and district levels by providing access to, and assistance with, data analysis and decision-making.

Overview	
Performance so far	
Aspects that helped the teachers the most	– Involvement of all stakeholders at all levels: Selection of state-level mentors to support district-level mentors, and the latter's support to teachers brought significant improvement in course uptake, completion and performance. – Setting up of helpline and communication channels like WhatsApp groups of mentors and teachers. – Peer networks for academic discussion: 75% of teachers consulted peer networks when faced with an issue. – Implementation of teachers' learnings in their classrooms: 95% of teachers recognized the course's connections with the newly introduced NCERT textbooks. – Data decentralization up to block level: State- and district-level mentors used it to assess the current completion of training and performance of teachers, and also to plan improvements in specific districts and blocks.
What has not worked	– Nomination rather than selection of state-level mentors made the supervision process less supportive. – Lack of data-mindedness among mentors acted as a barrier to effective and supportive monitoring. – Uncertainty and school closures during the COVID-19 pandemic prevented teachers from applying their learning in classrooms.
Minimum enabling conditions for deployment	– Smartphones with internet connectivity. – Supportive supervisory structure. – Communication channels for collaboration. – Large-scale pilot before implementation at full scale.

CASE STUDY 2 | Central government initiative to use digital medium for continuity in TPD



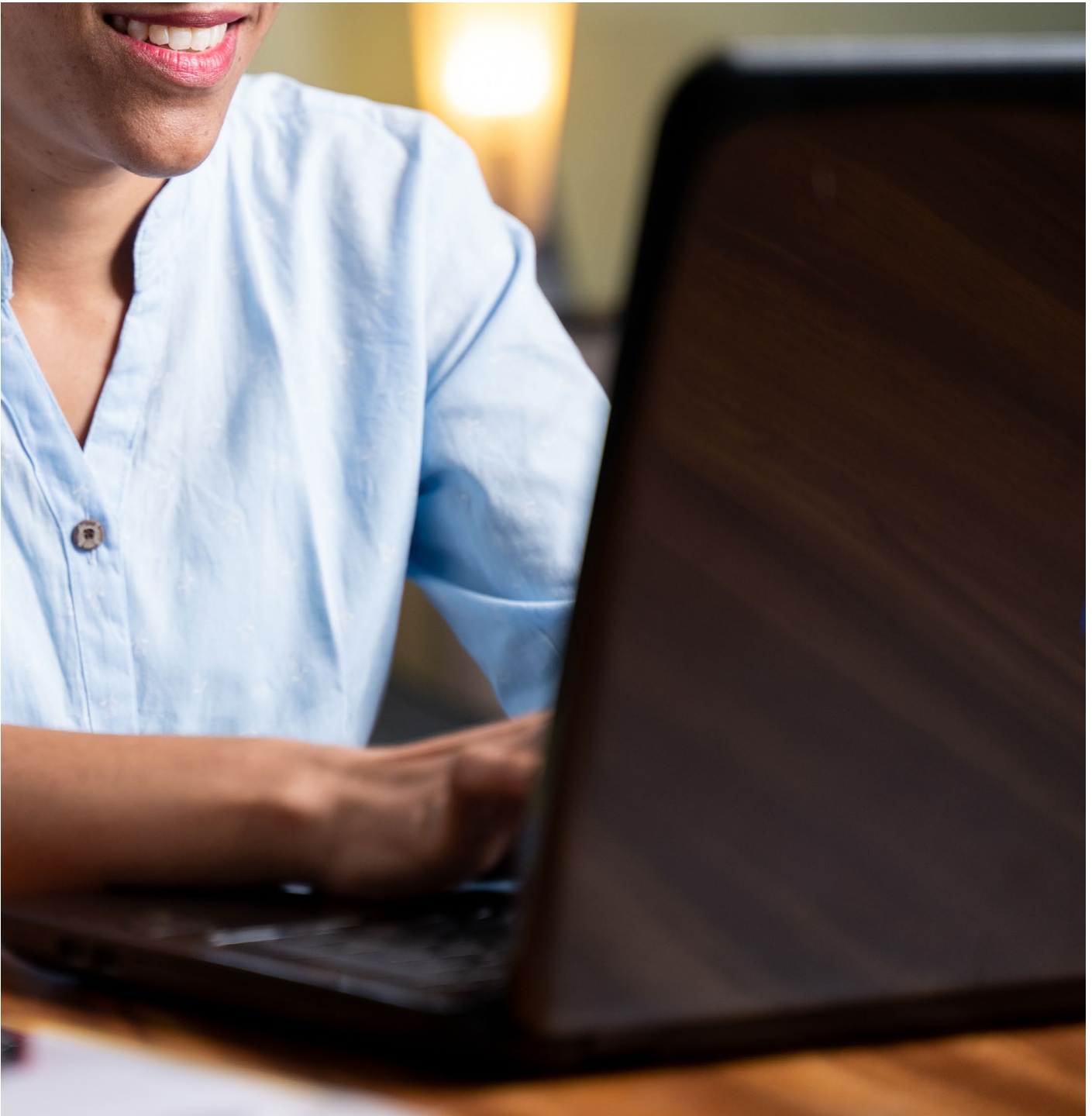
The National Initiative for School Heads' and Teachers' Holistic Advancement (NISHTHA) is an integrated programme under the Samagra Shiksha Abhiyan, a flagship programme of the Indian Ministry of Education. Courses for over 24 lakh (2.4 million) teachers from various school boards (organizations that design curricula and conduct examinations) such as the Central Board of Secondary Education, Council for the Indian Certification of Secondary Education and states/UTs' boards are being customized to run digitally all over the country via the DIKSHA portal. As per [NISHTHA Online](#), with the implementation of NEP 2020, the programme is being extended to teachers imparting foundational, secondary and early-childhood care and education (ECCE), including Anganwadi workers. (Anganwadis are rural child-care centres that provide supplementary nutrition, health, immunization and pre-school informal education, among other services.) These training modules include all the recommended areas of NEP 2020 and aim for teachers' holistic development.



4

School-to-work transition

Collaborative programmes that bring together businesses, schools and governments can ensure that skills and vocational training are in sync with industry needs.



4.1 Background

“ Research in India suggests that in the overall economy, formal training raises an individual's salary by 4.7% in comparison with an employee without formal training.

The employment landscape is changing fast globally, with new technologies emerging, greater focus on specialization and expanding globalization. With a median age of just 28 years, India has one of the youngest populations in the world, and its demographic bulge is expected to last until 2055.²⁴

The school-to-work (S2W) transition revolves around an individual's capacity to secure a rational path for their interests and build the capabilities necessary to cope with evolving skill requirements, technology and labour market conditions. Under India's Samagra Shiksha Abhiyan, a school-based vocational programme covering 55 courses aligned with the National Skill Qualification Framework (NSQF), job roles in 19 sectors have been defined and relevant courses offered to students from grade 9 to 12. According to data from the updated Unified District Information System for Education (UDISE+), a management information system of the central Department of School Education and Literacy, the number of schools offering these courses increased from 8,700 to 44,000 from 2015 to 2019.²⁵ The number now stands at 291,466, as per the latest data.

The 2022 budget speech stated that a new portal, DESH e-stack, would be launched “to empower citizens to skill, reskill or upskill”. The portal will provide trusted skill credentials, payment facility for training programmes and a platform to search relevant jobs and entrepreneurial opportunities. The NEP 2020 also sets 2025 as the target year for imparting vocational education to at least 50% of all students in school or higher education.

Currently, it is estimated that only 4.7% of India's total workforce has undergone formal skill training.²⁶ Moreover, according to the International Labour Organization, 81% of employed people in India work in the informal sector while only 6.5% work in the formal sector.²⁷ Together, these statistics highlight the intensity of the problem in retaining students in the formal skills training system and embedding skills that can establish a formal career path. To break the poverty trap, this transition from informal to formal vocational training is key, and hence building access to and enhancing the quality of education systems is critical to propel employment and entrepreneurship.

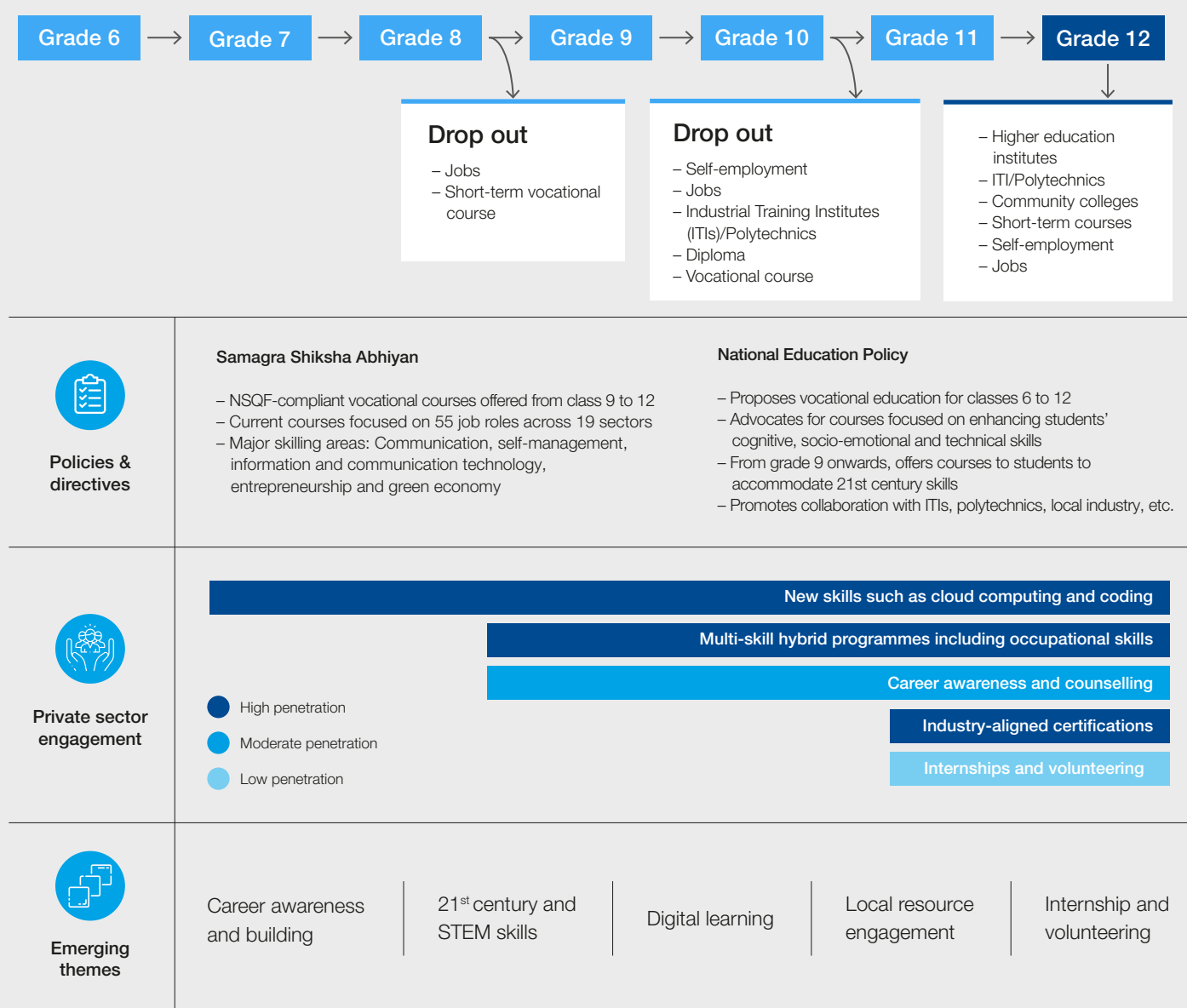
While 30% of India's youth (15-29 years) is not in employment, education or training,²⁸ women face even greater job inactivity, with 33% of female youth directly entering economic inactivity after school.²⁹ To address the barriers to workforce preparedness, especially for women, disabled youth and other marginalized populations, programmes must be carefully designed. They should be inclusive, flexible and contextualized, with sustainable structures that enable them to scale.

Research in India suggests that in the overall economy, formal training raises an individual's salary by 4.7% in comparison with an employee without formal training. In the primary sector, this wage increase is 36.9%.³⁰

The government, civil society and private sector have launched multiple programmes covering the S2W transition by providing vocational education in schools, among other interventions.



FIGURE 5 | Landscape of school-to-work transition in India



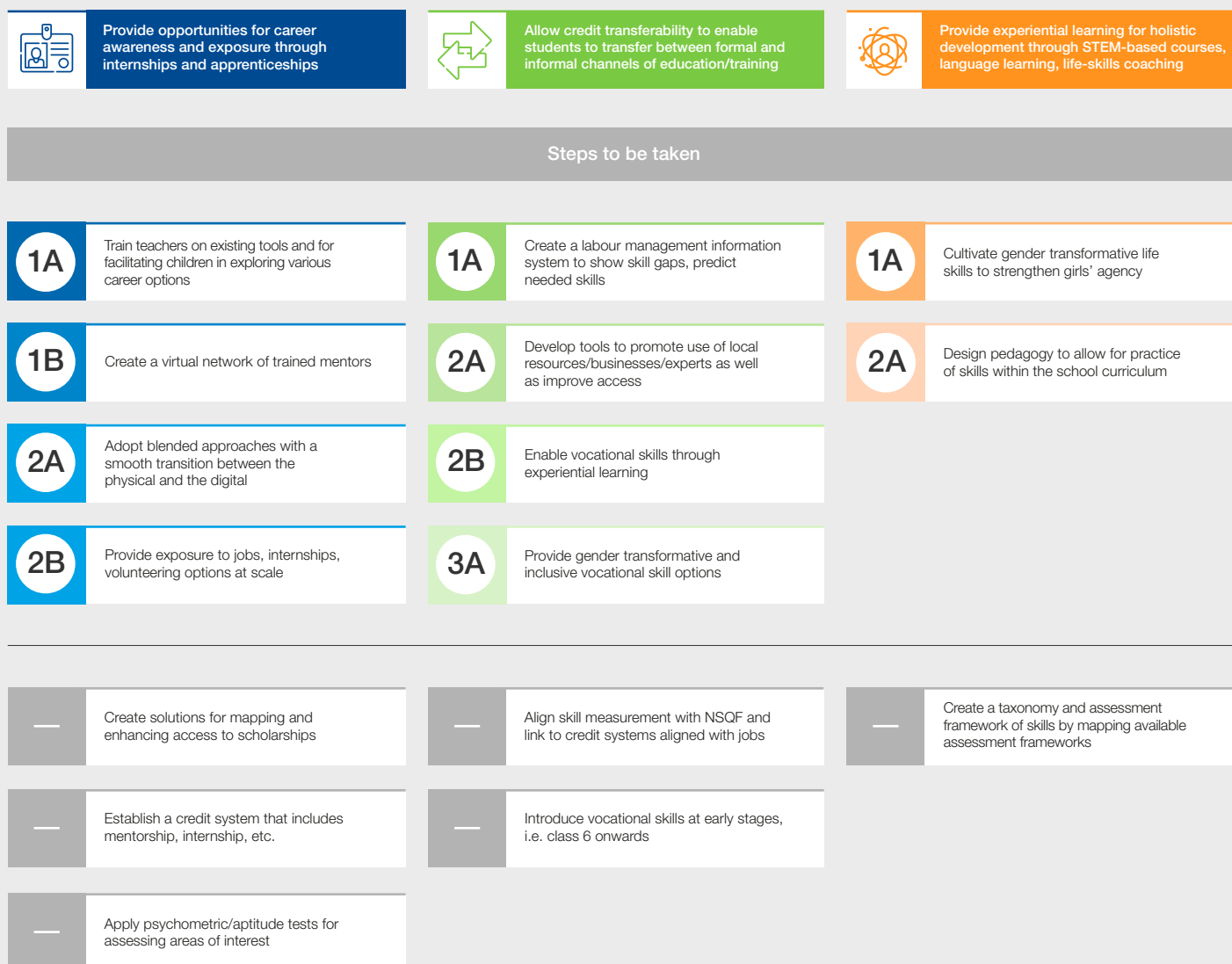
Source: Working Group discussions.

4.2 Overview of gaps

India has more than 60 million secondary and higher secondary students, but 85% of schools are yet to implement vocational courses as part of their curriculum.³¹ The S2W transition process is still facing major hurdles such as lack of trainers, inadequate resources and infrastructure, poor integration with the mainstream school curriculum,

and poor linkages between localized skill gaps and vocational courses. A lack of coordinated efforts has resulted in an isolated skilling ecosystem that has not been able to achieve its maximum potential. The KINDLE working group has identified three major gaps in this transition process in India for priority action.

FIGURE 6 Gaps prioritized by the working group



Source: [The Economic Times](#), [EdTech Review](#), [India Today](#), [TechNavio](#) and [Your Story](#).

“ Students should be given practical training through internships, apprenticeships, volunteering opportunities, etc. to enhance their exposure and to build the skills they will need for the 21st century workplace.

Interventions for gap 1: Enhancing opportunities for career awareness and exposure through internships and apprenticeships

Many students and parents consider vocational education to be the second-best option to mainstream education. This is mainly because they lack information and awareness about diverse career possibilities. In a survey of 10,000 participants, 93% of students were found to be aware of just seven career options, even though one estimate says 250 distinct career pathways are available in 40 domains covering 5,000 job roles in India.³²

This points to the need for training teachers on existing tools and approaches, so that they can facilitate children and parents in exploring different avenues.

Students should be given practical training through internships, apprenticeships, volunteering opportunities, etc. to enhance their exposure and to build the skills they will need for the 21st century workplace. However, as per a recent report, India has only 0.1% apprenticeship or internship engagement, with just 25,000 out of 6.3 crore (63 million) enterprises employing students for apprenticeships or internships.³³ Reasons include the lack of coordination between the government, schools and industry. Also, most internships are unpaid. NEP 2020 suggests a critical step in this direction, emphasizing local internships for students to get to know about local industries and the reality of work.

“ Improved mobility within the education system and greater industry acceptance could enhance the aspirational value of alternative pathways, both nationally and globally.

Interventions for gap 2: Allowing credit transferability to enable students to transfer between formal and informal channels of education and training

Employers expect students to have a high degree of competencies, skills and knowledge relevant to their work. They also prefer strong communication skills, teamwork, and problem-solving and critical-thinking abilities. At present, school pedagogy is designed with no reference to industry needs, since there are no formal channels for industry participation. Further, credits cannot be transferred between formal and informal education streams, so students who want to pursue higher education after vocational courses (or vice-versa) face difficulty in linking their credits. This discourages mobility between the two streams.

Improved mobility within the education system and greater industry acceptance could enhance the aspirational value of alternative pathways, both nationally and globally.

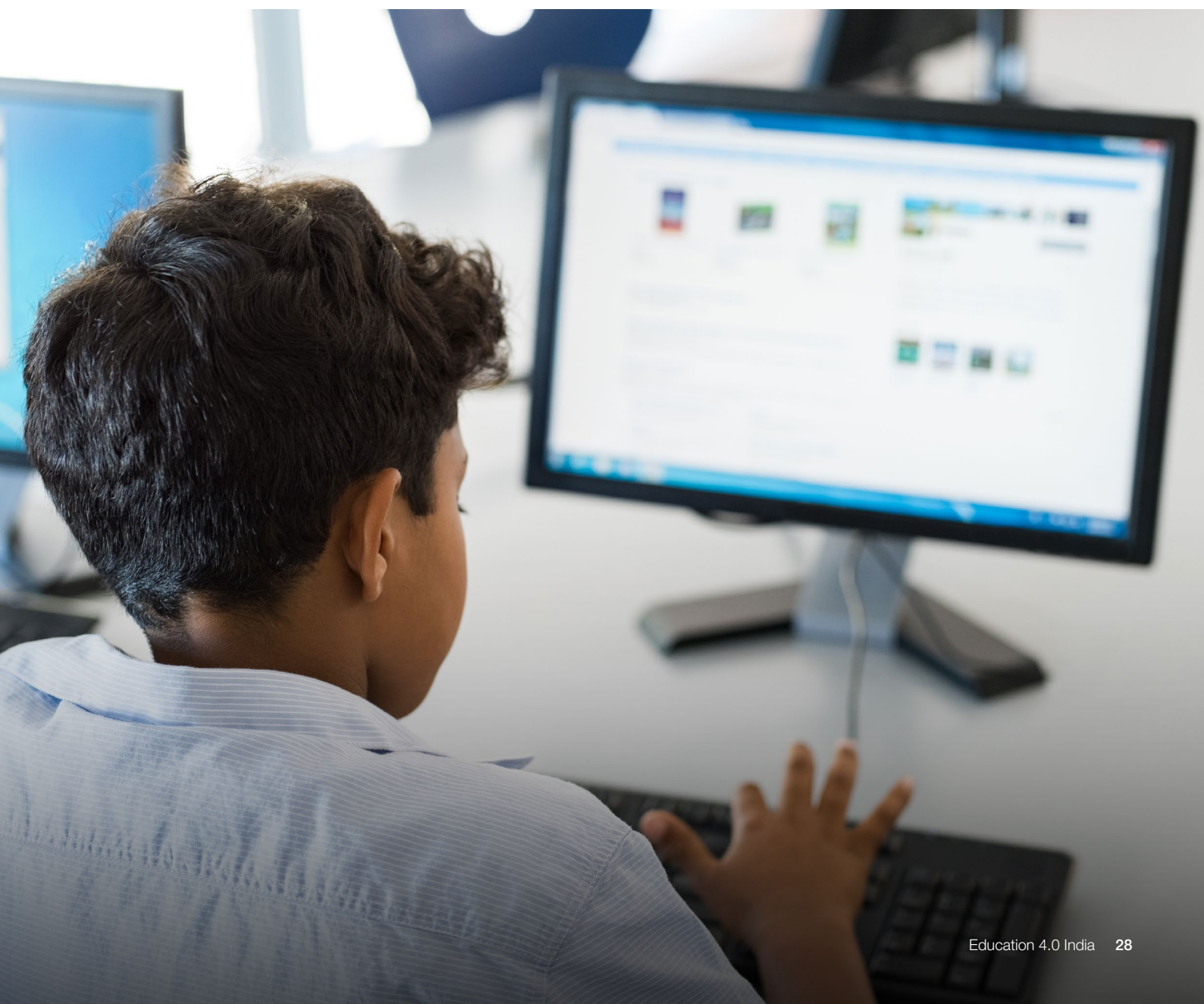
According to a UNDP report, a large proportion of India's youth is engaged in low-skill jobs compared to their qualifications because of a

lack of opportunities and other socio-economic factors.³⁴ This highlights the need for a robust and agile labour management information system (LMIS), which could track the demand for skills and competencies in a swiftly transforming world, and act as a feeder to the government as well as private sector innovators.

Interventions for gap 3: Providing experiential learning for holistic development through STEM-based courses, language learning and life-skills coaching

Future skill programmes are usually driven by experiential learning, which requires investment in physical infrastructure, resources and teachers' capacity building. However, since such programmes are not integrated with the school curriculum, this experience is mostly partial.

Where innovations and programmes have been integrated in private and government schools, such as coding programmes and experiential labs, these have been limited in scale due to lack of resources and flexibility to contextualize them for local communities and geographies.



4.3 Overview of school-to-work solutions

COVID-19 has served as a catalyst in accelerating digital adoption, and many NGOs, start-ups, corporations and governments have built solutions for promoting foundational, STEM,

21st century and occupational skills through the digital medium. This section presents an overview of solutions for each of the gap areas identified, along with a case study.

TABLE 6 Interventions for gap 1: Enhancing opportunities for career awareness and exposure through internships and apprenticeships

Solution	Unique features	Technology	Alignment with national priorities	Resources required to scale
Developing a labour management information system (LMIS) portal for internship/apprenticeship	Leveraging the LMIS portal to bridge the gap between employers and students by listing relevant internship and volunteering opportunities	Big data and ML	NEP 2020 advocates practical learning through internship/apprenticeship. Students should be provided first-hand experience of working in the real world to make them job-ready. Through internships and apprenticeships, students can apply the skills, knowledge and theoretical practice that they learn during the course	- Industry collaboration - Periodic access to digital infrastructure

CASE STUDY Internshala



Internshala is technology-based start-up that helps students find internships and online trainings. Its internship and apprenticeship

search service is free of cost for students, and it has a good network of employers from both government and non-government sectors to place students.

TABLE 7 Interventions for gap 2: Enabling credit transferability

Solution	Unique features	Technology	Alignment with national priorities	Resources required to scale
Enhancing digital skills through online certification courses	- Certifications focus on a range of skills from basic digital literacy to cloud computing - Content, assessment and certification equip students with skills for careers in growing fields - Skills are certified and recognized by industry - Projects/internships serve as capstones of educational/training experience	- Online platform - ML and AI for adaptive learning - Massive open online course (MOOC) - Learning management system (LMS) - Proctored assessments	India's PM eVIDYA initiative aims to boost and integrate all digital/online/on-air education to enable multi-modal access to education	- Basic digital infrastructure and digital literacy - Industry participation in design, implementation and placement

CASE STUDY Certiport



Certiport is an administrator of several industry-recognized, entry-level certifications from leading organizations. Its digital skilling programme provides certification courses to millions of students in 148 countries and in 26 international languages. This programme has multiple tracks to bridge skill gaps and help learners in their skilling journey towards specific jobs.





Solution	Unique features	Technology	Alignment with national priorities	Resources required to scale
Blended learning to provide flexibility – students can learn theoretical concepts online and practical concepts offline	– End-to-end support from student mobilization to placement – Equitable approach through blended learning to reach all socio-economic groups of students – Vertical and horizontal linkages to relevant education levels – Flexibility in student mobilization – LMC tracks every individual student's progress	– Online platform – MOOC – LMS – Proctored assessments	The Indian government has launched blended training models for higher education and NEP 2020 emphasizes blended learning through offline internships and practical exposure	– Multistakeholder management including state education boards, schools, universities and industry partners – Access to digital infrastructure

CASE STUDY

Pratham Education Foundation's hybrid skilling programme



[The NGO Pratham](#) mobilizes and trains youths through nearly 100 centres connected with more than 15,000 communities. This programme provides short-term skilling courses in the blended learning mode. For some courses, students can opt to attend the course through both online and offline media. The programme has established proof of scalability by training more than 1.5 lakh (150,000) students.





TABLE 7 Interventions for gap 2: Enabling credit transferability (continued)

Solution	Unique features	Technology	Alignment with national priorities	Resources required to scale
Non-digital solution leveraging existing government programmes	Integrated support from training to employment	– Integrated in the school curriculum and timetable – Improves retention and career awareness among students – Provides exposure to local employers for jobs – Single trade or multi-skill training focuses on occupational as well as soft skills	Courses are aligned with the National Skills Qualifications Framework of the central Ministry of Education and implemented under the Samagra Shiksha Abhiyan	– Stakeholder engagement and on-boarding – Capacity building of states to embed and scale models for long-term sustainability

CASE STUDY Lend a Hand India



[Lend A Hand India](#) (LAHI) has a catalyst programme that focuses on the integration of vocational education with existing school curricula for grades 9-12, supplemented with internships at medium, small and micro enterprises in grades 11 and 12. LAHI has entered into partnerships with 24 states and union territories to offer skill training in more than 10,000 schools covering more than a million high school students. LAHI uses a “project-management unit” model, wherein its staff works with the state education department to improve policy execution and capacity building. Through a multi-skill foundation model, LAHI exposes students in the 9th and 10th grades to multiple vocational courses so that they can choose their specific subjects in grades 11 and 12. This multi-skill course has approval from the National Skills Qualifications Framework.



TABLE 8 Interventions for gap 3: Providing experiential learning for holistic development through STEM-based courses, language learning and life-skills coaching

Solution	Unique features	Technology	Alignment with national priorities	Resources required to scale
Coding applications using ML and AI	– Programmes to enhance students' coding and cloud computing skills – Teacher training courses (pre-recorded) – Time-tabled lessons in classroom as well as self-paced courses – Courses implemented using smartphones or laptops – Enhanced computational thinking and logical reasoning skills to employability	– AI and ML for programming code evaluation and assessment – Natural language processing (NLP) for coding in local languages	– India aims for 70% adoption of automation in sectors such as healthcare, banking and finance, energy, telecom, transport and logistics – It needs to create a workforce for national priorities such as the Smart Cities Mission and Digital India	– Basic digital infrastructure and literacy – Buy-in from leaders and teachers – Monitoring and hand-holding mechanism for teachers and parents – Regional language-based coding programmes

CASE STUDY Bharat Mark-up Language



The Bharat Mark-up Language (BHAML) is an openly available software that students can download to code in HTML in their own local languages. BHAML aims to include 27 languages and 1,645 dialects so that any Indian student can code seamlessly in her/his mother tongue.

BHAML utilizes concepts of artificial intelligence and natural language processing for creating a unique experience. This has removed the barrier of language and coding for students studying in regional languages, enabling them to enhance their computational thinking and logical reasoning skills.



TABLE 8 Interventions for gap 3: Providing experiential learning for holistic development through STEM-based courses, language learning and life-skills coaching (continued)

Solution	Unique features	Technology	Alignment with national priorities	Resources required to scale
Experiential learning using new technologies	– Focuses on imparting STEM-based experiential learning – Offers school/ community-based physical or virtual labs – Imparts learning on abstract concepts – Enables experiential learning and collaboration	– Augmented reality and virtual reality for virtual experience – AI – Simulation	NEP 2020 advocates for practical and experiential learning for holistic development	– Resources and funds for capital expenditure – Alignment of the programme with course curriculum – Usage and adoption by educators

CASE STUDY **AeroBay's experimental learning course**



AeroBay is an upskilling edtech programme focused on imparting experiential learning solutions in science, technology, engineering, the arts and mathematics to school students. This empowers them to explore career and

entrepreneurship opportunities in the domains of Aerospace, Space, E-vehicles, Drones, Designing and related futuristic technologies. AeroBay also offers virtual lab-based experiences for students in seven states in India.



5

Connecting the unconnected

Edtech solutions and content must work in scenarios such as low connectivity and low bandwidth, and must be compatible with different devices.

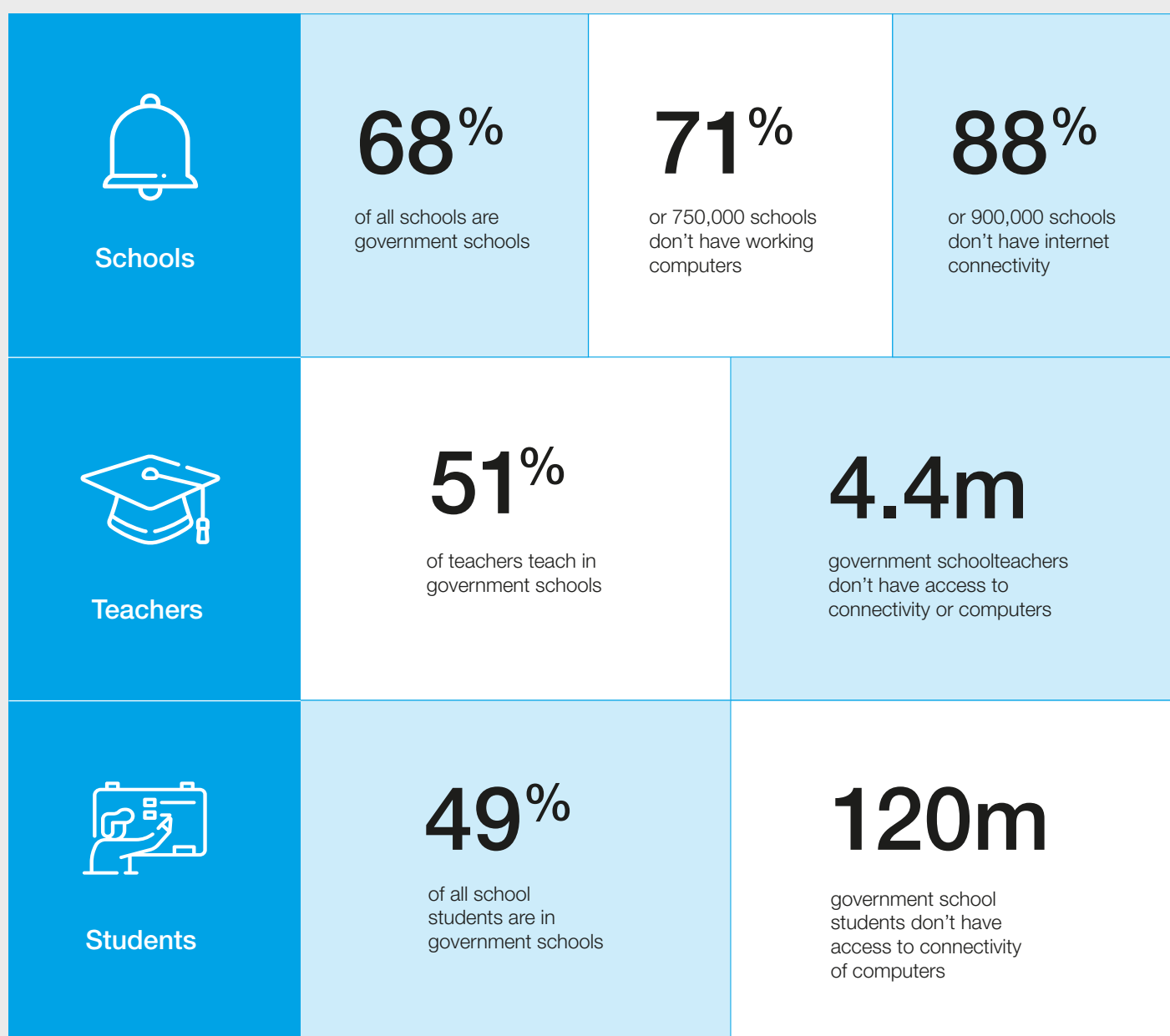


5.1 Background

Nearly 60% of schools do not have functional computers and 75% do not have internet connectivity.³⁶ Administrators and educators all over the country adopted various edtech solutions to maintain continuity of learning during the school closures caused by the pandemic. However, an appropriate strategy and action plan are required to reach every learner, and to connect those not yet connected to the internet, the digital world and related devices.

Edtech solutions must take into account varying scenarios such as low connectivity and affordability to offer either offline solutions or content that can play over low bandwidth. Content must also be compatible with different devices, available at multiple touch-points that various learners can access, and be localized. Connecting schools, individuals and communities with such solutions is vital for enhancing learning, reducing inequities in access and bridging the learning divide.

FIGURE 7 Indian schools and digital infrastructure



Source: UDISE+ report, 2019-20.

5.2 Overview of gaps

Many organizations are using emerging technologies to provide solutions such as blended models of interaction between teachers and students, virtual classrooms, remote learning and outcome-based remote programmes.

Various organizations have been conducting research and implementing pilot projects to understand the needs of educational institutions, students, teachers and parents, in order to build a strategic roadmap for effective and efficient programmes for outcome-based education. To this end, the KINDLE working group has focused on “connecting the unconnected” as one of its pivotal themes, within which it has identified the following four gap areas (figure 8).

1. **E-content:** The solutions include: (i) development of standards for content creation, (ii) development of localized and contextualized content, (iii) ensuring that content is inclusive and meets the needs of children with special needs (CWSN), and (iv) use of new and emerging technologies such as simulation and AR/VR for developing cutting-edge content to enhance the learner experience.
2. **Technology solutions for touch-points:** Solutions would improve the effectiveness of

learning at various touch-points, which are the points at which the learner interacts with the instructor, whether in person or digitally, synchronously or asynchronously. Meeting learners’ requirements would need (i) scaling of the solutions, (ii) blended solutions, (iii) use of analytics for informed decision-making, and (iv) AI/ML for personalized learning.

3. **Access to devices:** By adhering to existing frameworks such as NDEAR and creating access for learners, the focus for this priority area includes (i) defining open-source hardware standards, (ii) creating access using multi-modal devices, and (iii) providing solutions for end-user devices (“edge computing devices”, which use a distributed form of computing in which computation and data storage are done closer to the sources of data, improving response times and saving bandwidth).
4. **Access to the internet:** This entails exploring online and offline solutions, including (i) solutions for connecting schools, (ii) using offline solutions in low/no-connectivity areas, (iii) PPP models to cater to demand for connectivity, and (iv) network-aware quality of service (QoS) solutions that guarantee that applications and traffic will run under limited network capacity.

FIGURE 8 Solutions for connecting the unconnected

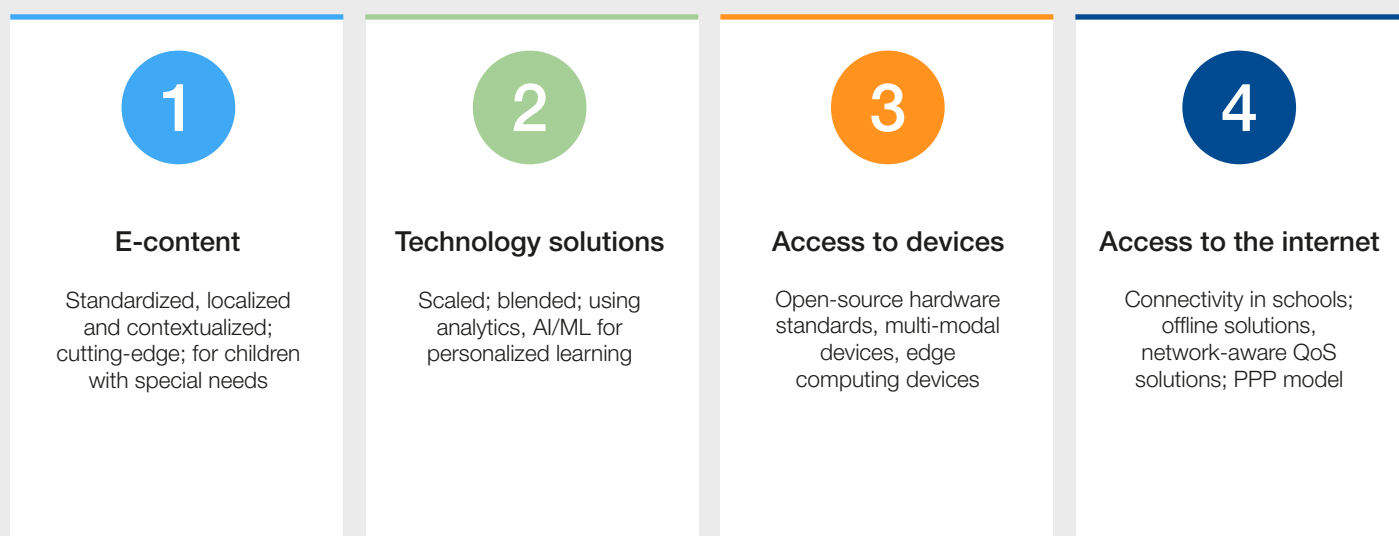


FIGURE 9 | Viability and potential impact of recommended solutions

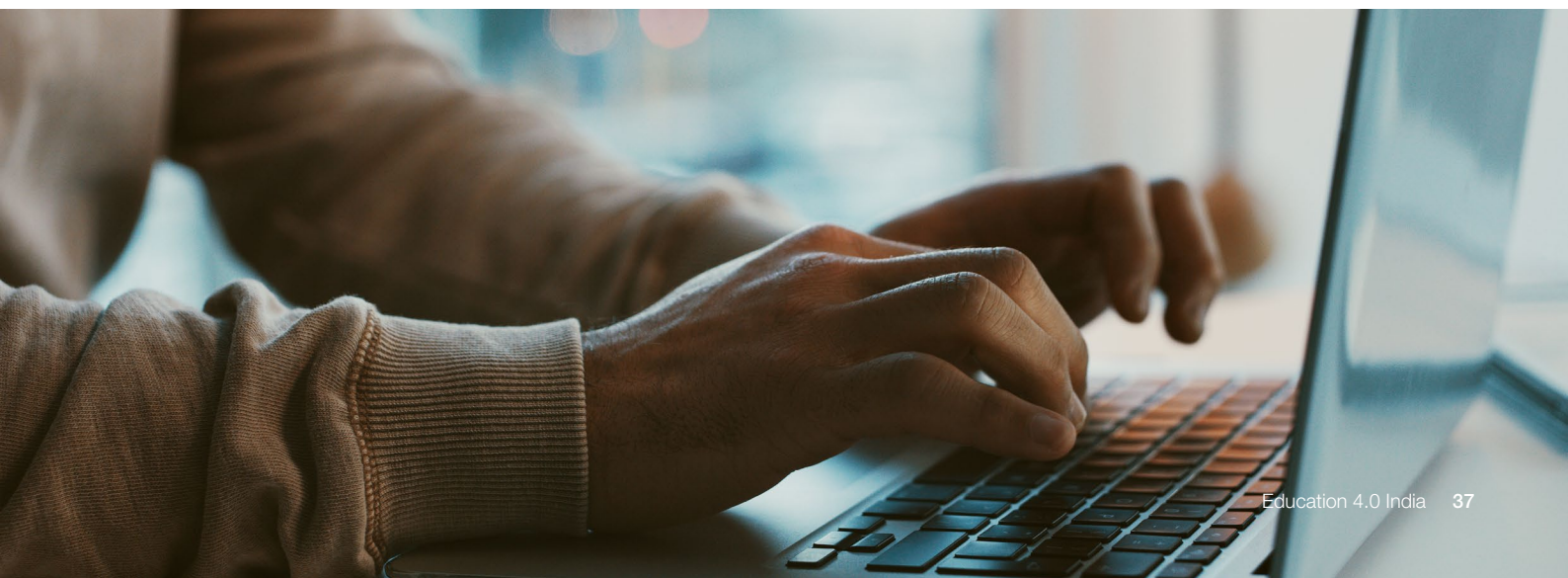


Source: Working group discussions.

5.3 Identification of priorities

Connecting the unconnected entails reducing the digital divide, narrowing the rural-urban divide and empowering the ecosystem. To identify the most viable and impactful solutions, the working group carried out an in-depth analysis of more than 60

initiatives and practices, while keeping the learner at the centre. It identified the following interactive and interoperable solutions to address the four focus areas on priority.



“ To provide contextualized content in the preferred medium, it is also important to create guidelines for content providers to localize and contextualize existing content.

Intervention for gap area 1 (e-content): Developing a common taxonomy, content guidelines for localization and enabling mechanisms for curation and discoverability of e-content.

E-content includes all the content created and delivered through the digital medium. The learner base is diversified, for instance, in terms of content for different mediums of instruction, education boards and learners' geographical and linguistic diversity.

The learner and teacher can consume different types of content on different devices (TV, mobile device, etc.) and in various places of learning (classroom, smart classroom, community centre, through volunteers/mentors and through devices for self-learning). Content can be created by different content providers.

To achieve this unbundled yet cohesive approach, it is important to develop a common taxonomy or content classification standard that all content creators must adhere to. A common taxonomy also ensures that the content is granular, specific to a particular topic and is discoverable by the learner and teacher.

To provide contextualized content in the preferred medium, it is also important to create guidelines for content providers to localize and contextualize existing content.

Standards are also required for new and evolving types of content such as that using AR, VR and mixed reality (MR), content for CWSN and content for creating assessments. Standards for assessments are extremely important as the assessment data must provide comparable indices. Only then would actions taken on this data be comparable and replicable.

The content created must not only adhere to the taxonomy but must also be of high quality in terms of audio, video, simulation, AR and VR, and must be factually correct. A mechanism needs to be put in place to ensure that only curated content is published and provided to the learner and the teacher.

CASE STUDY

OLabs (online and virtual labs) for school experiments funded by the Indian Ministry of Electronics and Information Technology (MeitY)



OLabs is an educational initiative funded by a research grant from MeitY under which the Centre for Development of Advanced Computing (CDAC), an autonomous Indian scientific society, has partnered with the **Amrita Center for Research in Analytics, Technologies & Education (AmritaCREATE)** to create content. The lab hosts mathematics and English lessons, as well as experiments in physics, chemistry and biology for classes 9 to 12, with content aligned to the central and state board syllabi. Access to OLabs is free for schools that register.

During the pandemic, OLabs' 172 science and math high school labs served over 32 lakh (3.2 million) unique users and approximately 50,000 schools were trained on using its content.

AmritaCREATE and CDAC have received new funding from both MeitY and the Ministry of Education to build additional labs to offer content in computer science, entrepreneurship, Indian sign language, social science, Sanskrit, Hindi, etc. Some 10% of OLabs' content is to be AR/VR and will be placed under the DIKSHA platform, thus making it available to millions of schoolchildren for free. The content versions to be developed in future will also be NDEAR-compliant and serve the students learning through the National Institute of Open Schooling as well.

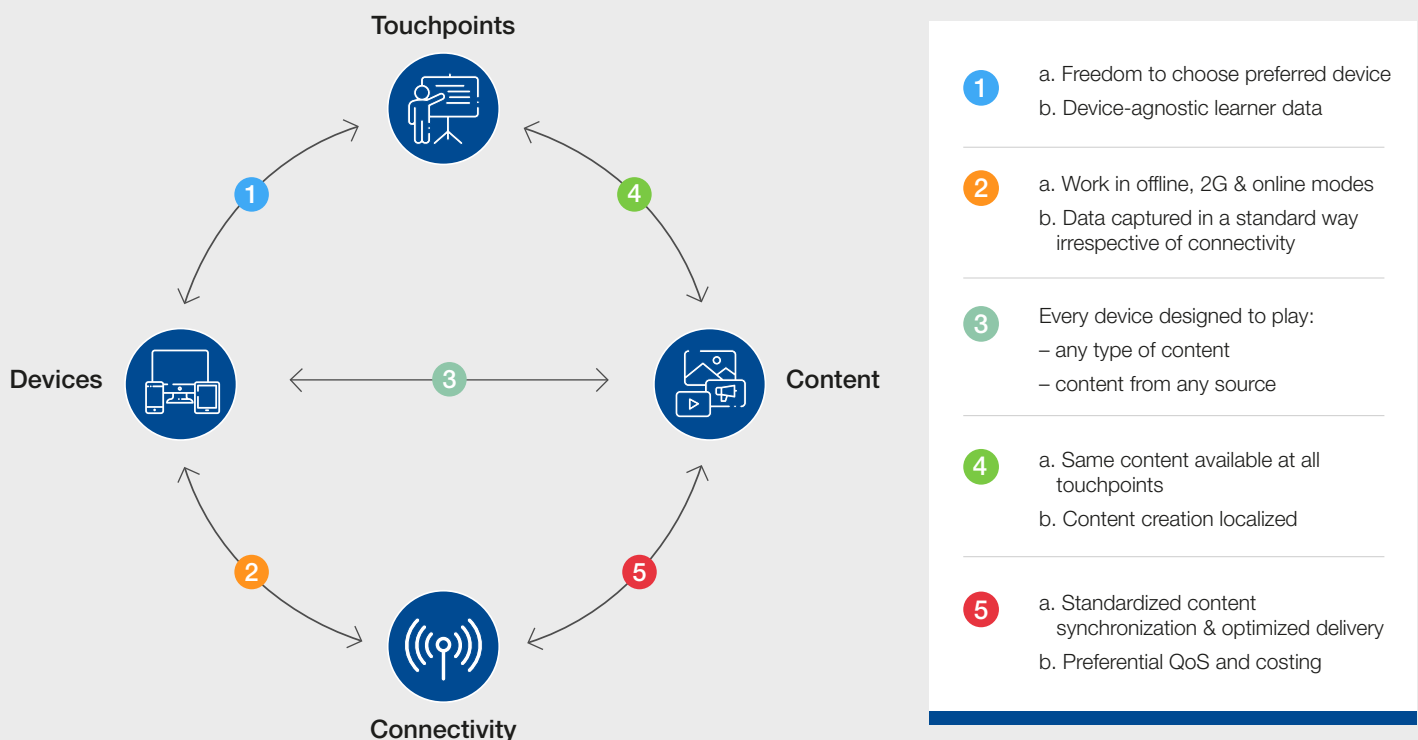
Go lab, the largest EU-funded consortium of school virtual labs, has endorsed OLabs, linking its labs with nearly all of OLabs's science labs for use by teachers in Europe. The content is available in three Indian languages and the NCERT has used it to train rural teachers.



Interventions for gap area 2 (technology solutions for touch-points): Developing standards, decoupling the elements of digital learning

FIGURE 10

De-coupling the interactions between various touch-points



Source: Working group discussions.

Students interact with teachers (in-person or virtually) at various touch-points (points of learning) such as the school, community centres, mentor- or volunteer-led groups and during self-learning. To ensure continuity of learning as the student moves from one point to another, standards must be established for the technology solutions provided at various touch-points.

Technology solutions based on standards would help decouple the elements of digital learning, ensuring continuity and consistency while providing a single, uniform view of the student's academic progress.

Some critical elements are:

- Freedom to choose a preferred device
- Device-agnostic learner data
- Availability of offline, 2G and online modes
- Capture of data in a standard way irrespective of connectivity
- Content compatibility with any device

- Availability of the same content at all touch-points
- Localized content creation
- Content synchronization, standardization and delivery optimization
- Special data tariffs for educational content

Implementing these elements would need capacity building at the grassroots level.

Through capacity building programmes, teachers, community members, mentors, volunteers, parents/guardians and students must be made aware of the options available for devices, content and connectivity. The various choices must also provide a unified view of learning and teaching.

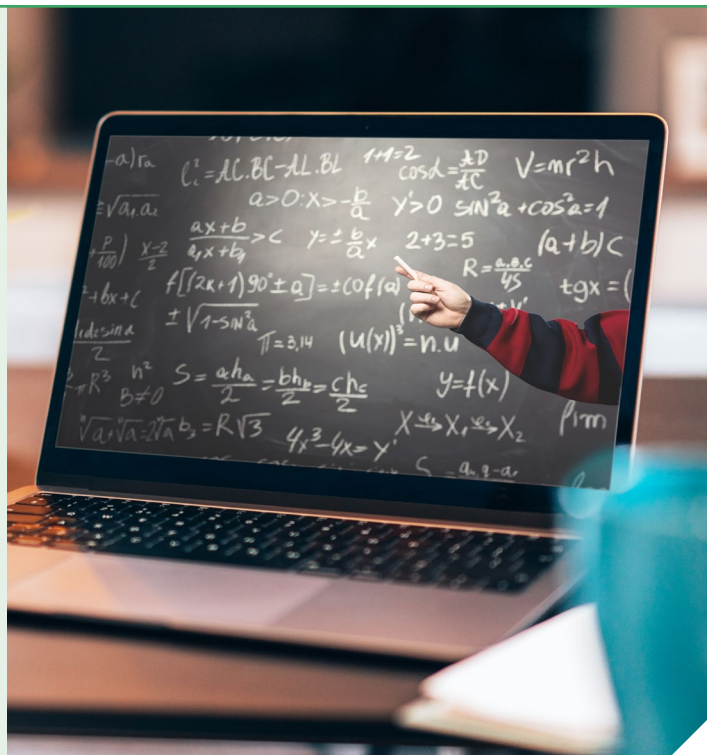
The existing network of digital service providers such as MeiTY's Common Service Centres may be utilized to facilitate content dissemination, capacity building and adoption of these initiatives and programmes.



[The Common Service Centres \(CSC\)](#) scheme is an initiative under the Digital India Programme of MeitY. These centres are run by village-level entrepreneurs (VLEs) and deliver various government-to-citizen and business-to-citizen services. CSCs also have a special focus on educational services. Dedicated centres called CSC Academies are run in every state and are equipped with infrastructure for e-learning and computer-aided courses.

The state government of Jharkhand, through the Jharkhand Council of Educational Research (JCERT), has leveraged CSC Academies located in each rural block to create awareness among students, teachers and communities about free courses available on the [DIKSHA](#) platform. A master trainer workshop at the state headquarters has trained over 300 participants from 260 blocks of the state.

The training demonstrated how to use the DIKSHA platform and how to scan QR codes to access energized textbooks (that provide weblinks to related content in the form of videos, etc.). Master trainers learned how to further disseminate their learnings and conduct campaigns to enable teachers and students in far-flung rural areas to use DIKSHA's teaching and learning resources.



Interventions for gap area 3 (access to devices): Defining open-device specifications, hardware and software specifications, and ensuring interoperability of content and device

Decentralized learning needs access to devices that are compatible with various kinds of technology-enabled content and data capture in both offline and mixed modes. This would require:

- Standards for federated learning (a machine learning technique that trains an algorithm using multiple decentralized devices that hold local data)
- Standards for open-source hardware
- Specific devices selected for open-source hardware
- Open-source hardware that includes edge computing and telemetry capability (to collect data and transmit it for monitoring, etc.)
- Hardware standards for CWSN
- A market for entrepreneurs to create solutions

Intervention for gap area 4 (access to the internet): Developing online and offline solutions to mitigate connectivity challenges, and finding quality of service solutions for access to the internet

The quality and availability of connectivity, interoperability and partnership models would be key enablers to solve the challenge of connecting the unconnected.

This would need:

- Quality of content based on the quality of the network
- Type and quality of content based on the device delivering the content
- Content compression and decompression techniques
- Content from various sources to work on different devices
- Telemetry/ML from various devices to be interoperable
- Interoperability of offline solutions



The Digital Infrastructure for Knowledge Sharing, [DIKSHA](#), is a national platform for school education that provides teaching and learning tools for India's education ecosystem to achieve learning goals at scale.

It has been adopted by almost all the states and union territories of India as well as the various school boards. DIKSHA can be accessed by learners and teachers across the country and currently supports uploading of content in 36 Indian languages. Each state or union territory leverages the DIKSHA platform in its own way, using the varied capabilities and solutions that the platform offers to design and run programmes for its teachers and learners.

Keeping in mind the constraints on the availability of internet-powered devices, DIKSHA offers content telecast through television channels and linked through QR codes. Through DIKSHA, these broadcasts as well as other digital resources can be accessed anytime, anywhere, thereby ensuring inclusive and equitable access to quality digital content for everyone.

During the pandemic, learners and teachers throughout the country made unprecedented use of DIKSHA, paving the way for its continuing use.



5.4 Enabling schools to acquire digital infrastructure

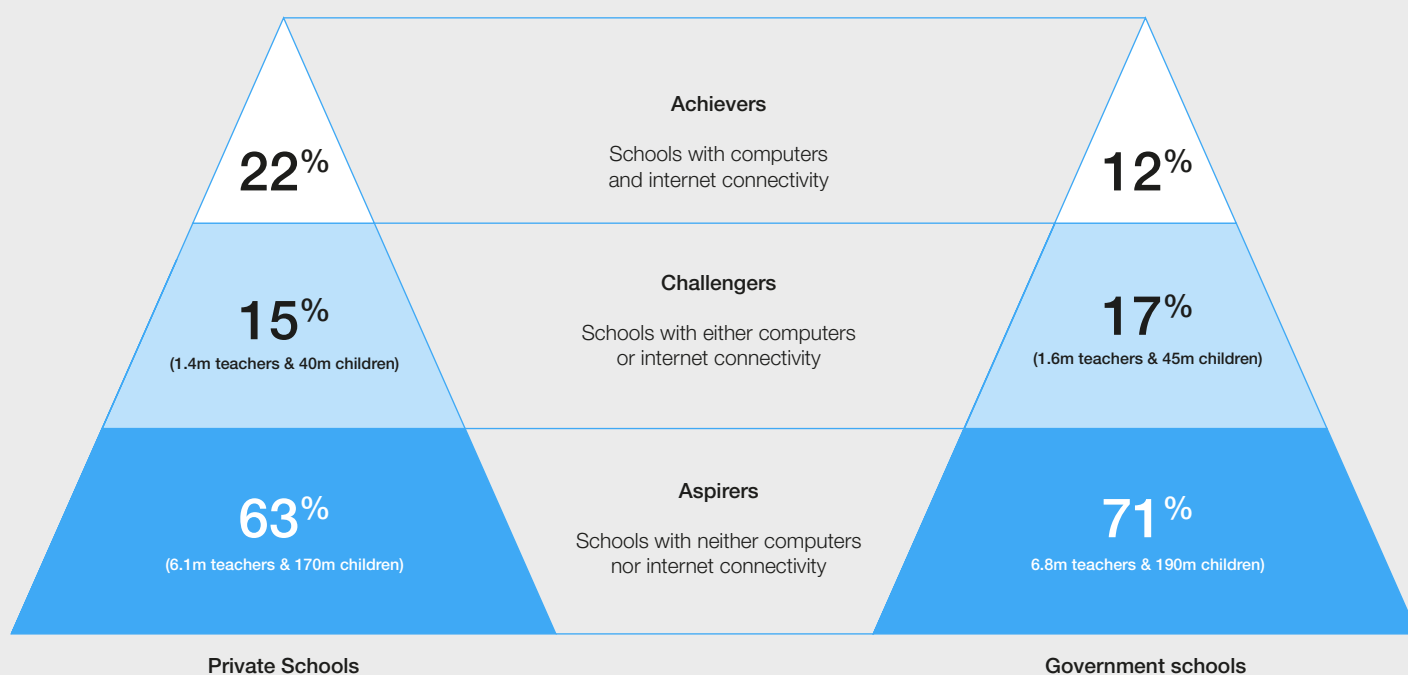
The working group has categorized the schools into three sets, depending on the digital infrastructure available:

1. Achievers: Schools with both devices and connectivity

2. Challengers: Schools with either devices or connectivity

3. Aspirers: Schools with neither devices nor connectivity

FIGURE 11 Schools and digital infrastructure



Source: UDISE+ report, 2019-20.

Table 9 maps the shortlisted solutions to the three categories of schools.

TABLE 9 Solutions for each of the school categories

Category	Solution	Achievers	Challengers	Aspirers
Touchpoints	AI / ML for personalized learning / teaching	●	●	
	Data driven decision making	●	●	
	Recommendations to teachers	●	●	
	Volunteer network	●	●	●
	Synchronized learning / teaching	●	●	
Device	Managed Service Entrepreneurship	●	●	
	Open Source HW	●	●	
	Edge computing devices	●	●	
	IT Champions	●	●	
	Community device sourcing		◐	●
	Infradaan		◐	●
Connectivity	Interoperable offline solutions	◐	●	
	Connecting all GPs		◐	●
	Network aware QoS	◐	●	
	PPP	◐	●	●
	Offline Solutions	◐	●	
Content	Content for CWSN	●	●	
	Automatic Translations	●	●	
	AR / VR / MR	●	●	
	eContent Standards	●	●	
	Content crowdsourcing	●	●	
	Taxonomy	●	●	●
	Assessment Standards	●	●	●

Source: World Economic Forum



Equipping schools with devices and technologies is the key to connecting the unconnected. The solutions listed above should help schools transition to the status of Achievers.

Figure 12 provides a 2x2 matrix with the school categories (Achievers, Challengers and Aspirers) mapped to the solutions. This helps understand the change process. The four quadrants are as follows:

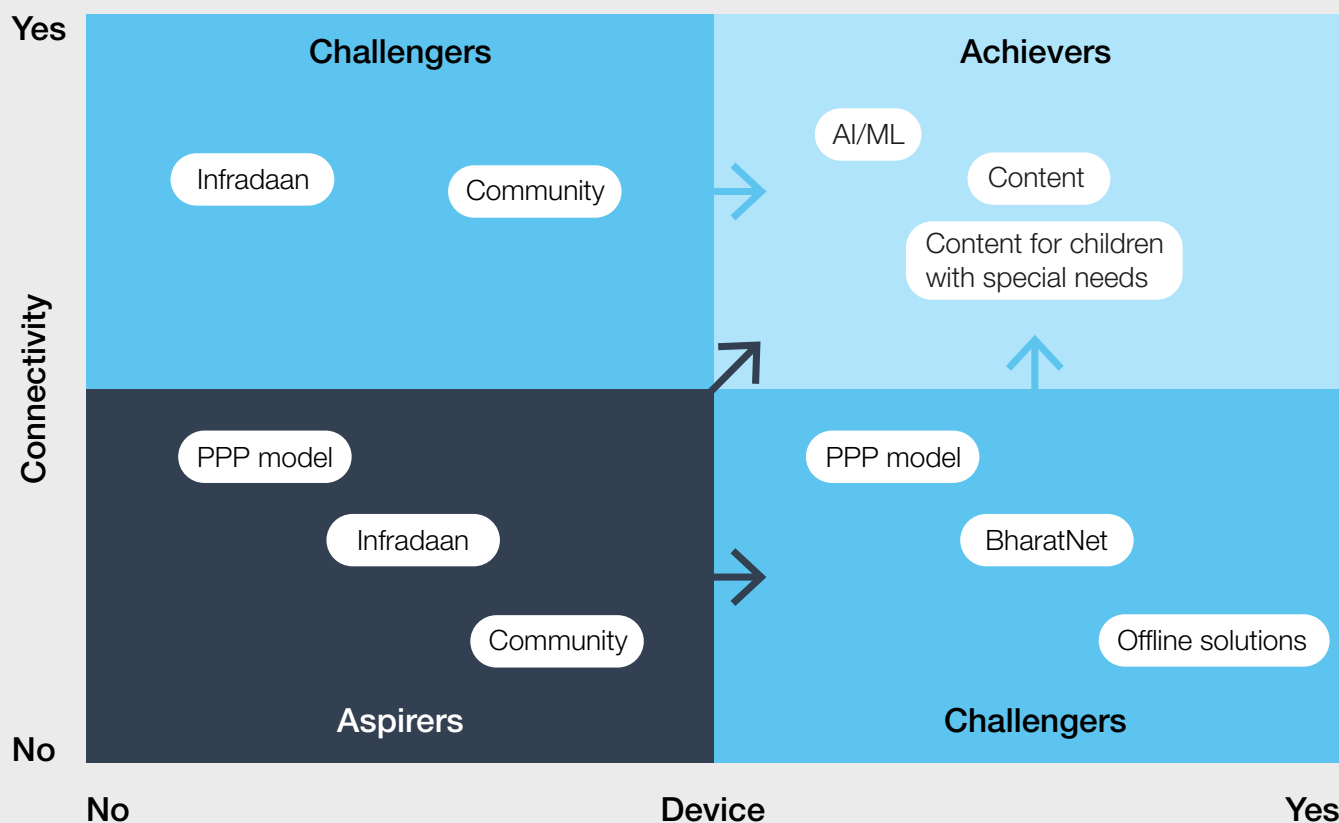
1. Top right (Achievers): Schools with both connectivity and devices.
2. Top left (Challengers): Schools with connectivity but without devices.
3. Bottom right (Challengers): Schools with devices but no connectivity.
4. Bottom left (Aspirers): Schools with no internet or devices.

For example, for a school with no internet and no computers (an Aspirer), solutions such as community-based learning and “Infradaan” (donation of devices for wider use in education) could push the school to the Challenger category (with devices but no internet connectivity).

By implementing the solutions recommended for the Challenger category, a school would get fully equipped with both internet access and devices, thus achieving the goal of connecting the unconnected (where a community, school or individual is equipped with a device, technology, internet access and various supporting infrastructure for continued learning).

The recommended solutions would support all schools, at various levels of infrastructure availability, to become Achievers.

FIGURE 12 Transitioning to Achiever status



6

Recommended interventions

The Education 4.0 India initiative suggests a modular approach in which identified solutions can be tailored to suit the target beneficiaries, different sizes of geographies and diverse teaching/learning environments.



6.1 Methodology for designing interventions

“The interventions must be designed to be not only impactful but also highly scalable, cost-effective and sustainable.”

The KINDLE initiative focuses on four themes – foundational literacy and numeracy, teacher professional development, school-to-work transition, and connecting the unconnected. The purpose of the initiative is to create significant, population-scale impact through a set of carefully designed and calibrated interventions under each of these themes.

The interventions must be implemented in a coordinated and complementary manner to produce the desired impact, which can be measured in terms of the outcome parameters before and after the intervention. The interventions must be designed to be not only impactful but also highly scalable, cost-effective and sustainable. To ensure these requirements, a streamlined, consistent methodology for designing the interventions has been followed. Figure 13 gives an overview of the methodology followed.

Step 1A: A landscape survey of each theme was carried out to identify the gaps that impede progress in achieving the relevant goals. These gaps were prioritized, based on qualitative assessments made by the working groups. The top three gaps were identified under each theme, applying the Pareto principle, such that addressing

20% of the gaps will lead to an 80% improvement in outcomes.

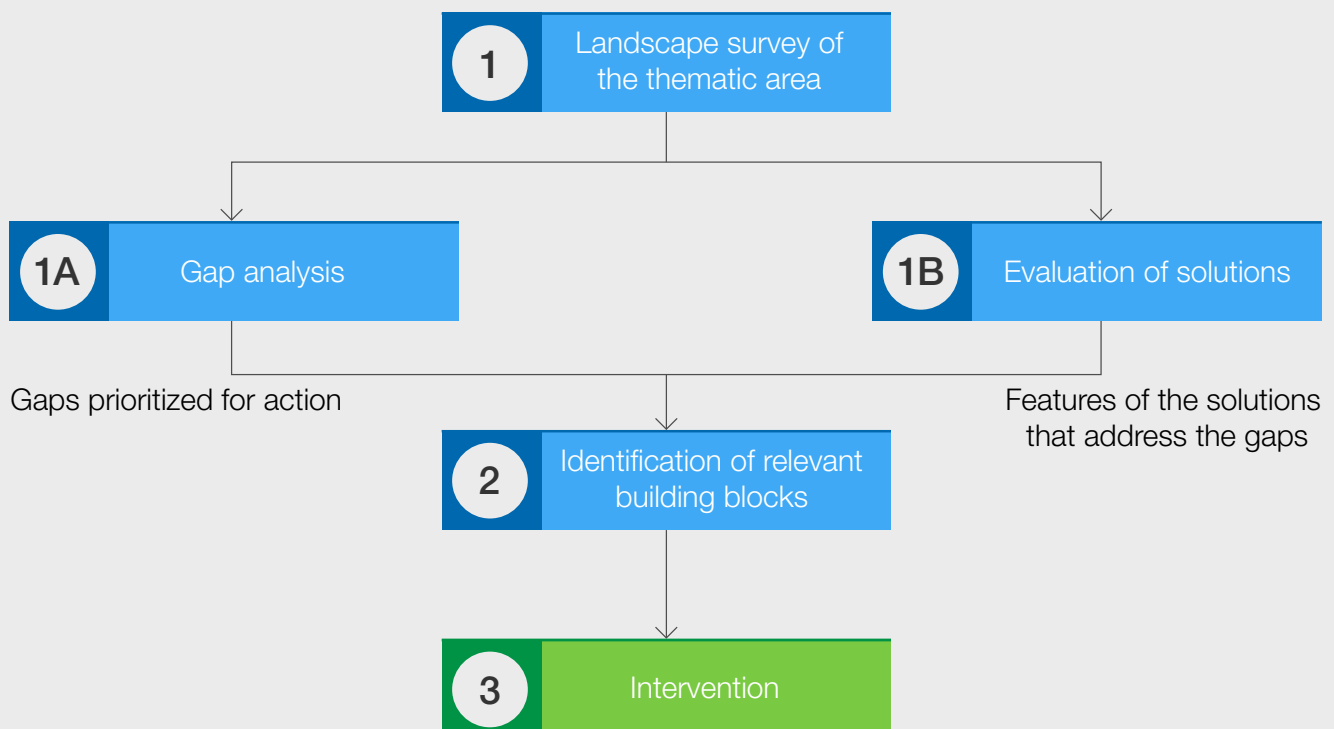
Step 1B: The existing edtech solutions relevant to KINDLE were examined from the perspective of how closely they address one or more gaps in the relevant theme, the maturity of the solution and its footprint. The key features of the most successful solutions appropriate to the theme were then identified and incorporated into the design of the intervention.

Step 2: A set of five basic building blocks was identified by choosing the most suitable features of the solutions studied. The nature and purpose of these building blocks is explained in the next section. They are meant to address the prioritized gaps in each theme.

Step 3: Each intervention was then defined, taking inputs from the gap analysis and the building blocks identified.

The proposed methodology ensures that each intervention is designed to address the key gaps, using the key features of proven solutions. The use of building blocks enables scalability, standardization and ease of implementation.

FIGURE 13 Methodology for designing interventions



Source: Working group discussions.

Building blocks of interventions

The five building blocks make it possible to design interventions that are contextualized to local

requirements in various states. All the interventions recommended in this report can be built using different combinations of these building blocks, which are depicted in **Figure 14**.

FIGURE 14

Building blocks of KINDLE interventions



Source: Working group discussions.

TABLE 10 | KINDLE building blocks explained

Building block	Sub-component	Value addition of the building block
Curriculum	Curriculum for: - Capacity building - Foundational literacy and numeracy 21st century skills - Competency-based education	- Ensures a common minimum quality of education - Addresses the emerging needs of educational outcomes (FLN, TPD, competency-based education) - Is reusable across India through localization and contextualization
Content	- Content standards - Content lifecycle management - Localization and contextualization	- Raises the bar in terms of the quality of education - Provides the ability to draw and combine content from multiple sources to meet curriculum needs - Creates capability to use: - AI-based tools for contextualization and personalization - AR/VR/MR tools for creating immersive content - Ensures a continuum of education
Capacity	- Competency framework - Training needs analysis - Training delivery	- Personalized training/TPD - Better accountability for educational outcomes
Community	- Volunteering - Crowdsourcing - Self-sustainability	- Provides for stakeholder engagement, involvement in shaping and realizing educational outcomes - Enlarges the pool of the right content - Changes the government's role from a regulator to an enabler and facilitator
Digital infrastructure	- Devices and hardware - Connectivity solutions - Data for AI/ML solutions	- Narrows the digital divide - Bridges the rural-urban divide - Empowers the ecosystem players through better analytical and prediction capabilities

The KINDLE initiative needs to undertake further work in the detailed design and specifications of these five building blocks. Such an effort, to be developed and promoted as the KINDLE Toolkit, would enable wide adoption of KINDLE initiatives throughout the country.

These building blocks and specifications would spur significant work in refining and realigning the existing edtech solutions to the initiative's priorities and, more importantly, catalyse the development of impactful and innovative solutions by the start-up community.



6.2 Overview of KINDLE intervention map

“ The KINDLE architecture is based on two horizontal layers and three vertical layers. It is modular in the sense that more verticals can be plugged into the same horizontals.

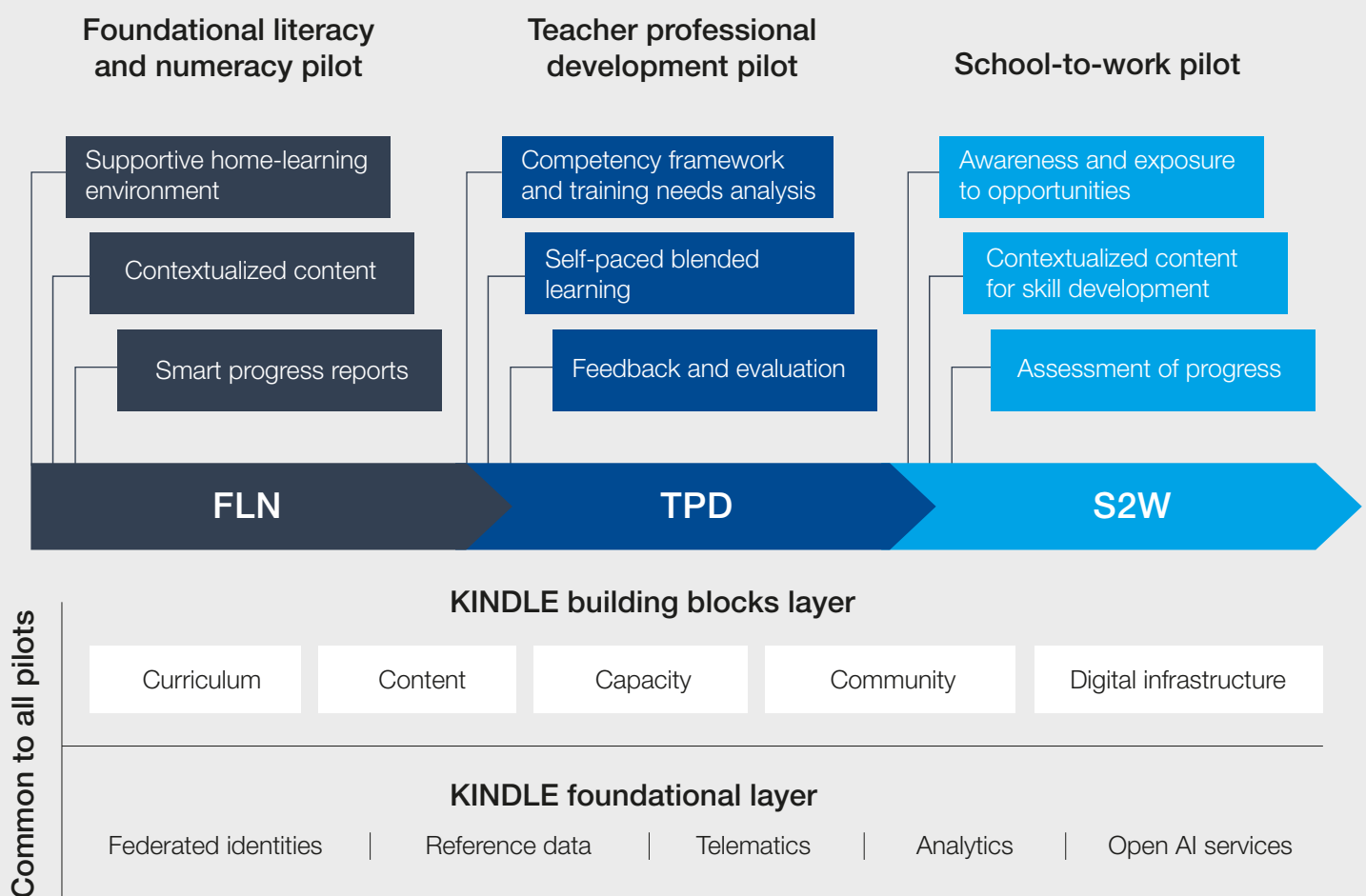
The KINDLE initiative is built on the principle of **modularity** to provide flexibility in designing pilots and rollout strategies. The interventions can be built out of the five building blocks in a modular manner such that the implementation can be tailored to suit the target beneficiaries, different sizes of geographies and diverse teaching/ learning environments.

Three interventions have been recommended for each gap to be addressed on priority.

Figure 15 depicts the KINDLE intervention map. The rationale of the map and its salient features are:

- i. The KINDLE architecture is based on two horizontal layers and three vertical layers. It is modular in the sense that more verticals can be plugged onto the same horizontals.
- ii. The **KINDLE foundational layer** derives out of the core building blocks of NDEAR, which are useful in digital efforts all through the education landscape. For instance, “federated identities” provide
- iii. The **KINDLE building blocks layer** provides the flexibility of designing interventions that are custom-designed to suit the widely varying environments of education in different states.
- iv. The pilots (and potentially, the rollout) leverage the horizontal layers and consist of three interventions each, as depicted. The activities and outcomes of the interventions are described in subsequent sections.
- v. While the pilots illustrated below have been named after each theme, it is more appropriate that the actual pilots be designed with a broader scope, dovetailing with the ongoing education sector programmes for developing civil infrastructure, providing budgets for the operational costs, complying with the norms for teacher-student ratio and so on, to ensure that the delivery is holistic and integrated.

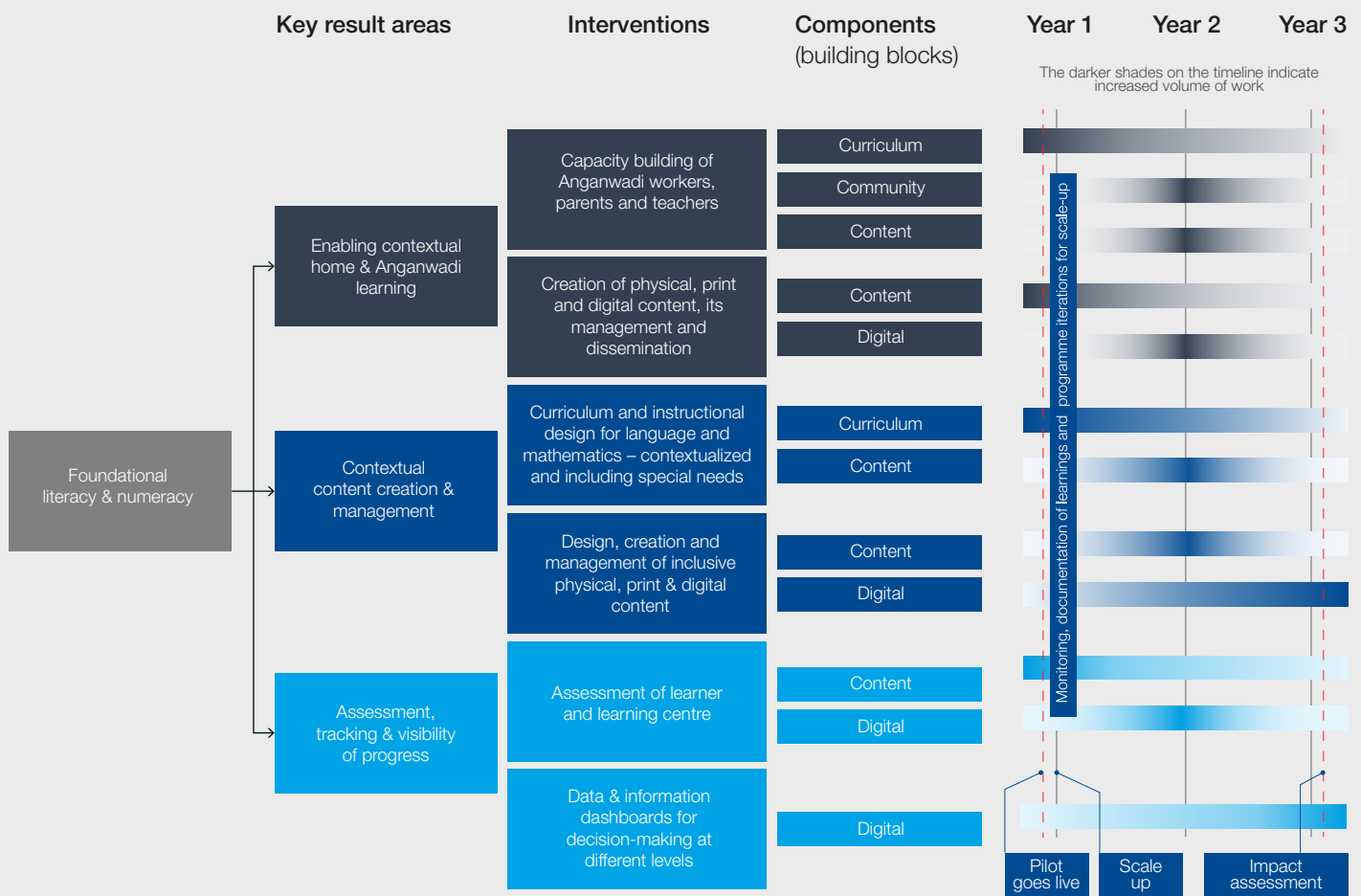
FIGURE 15 KINDLE intervention map



Source: Working group discussions.

6.3 FLN-centric interventions

FIGURE 16 FLN-centric interventions



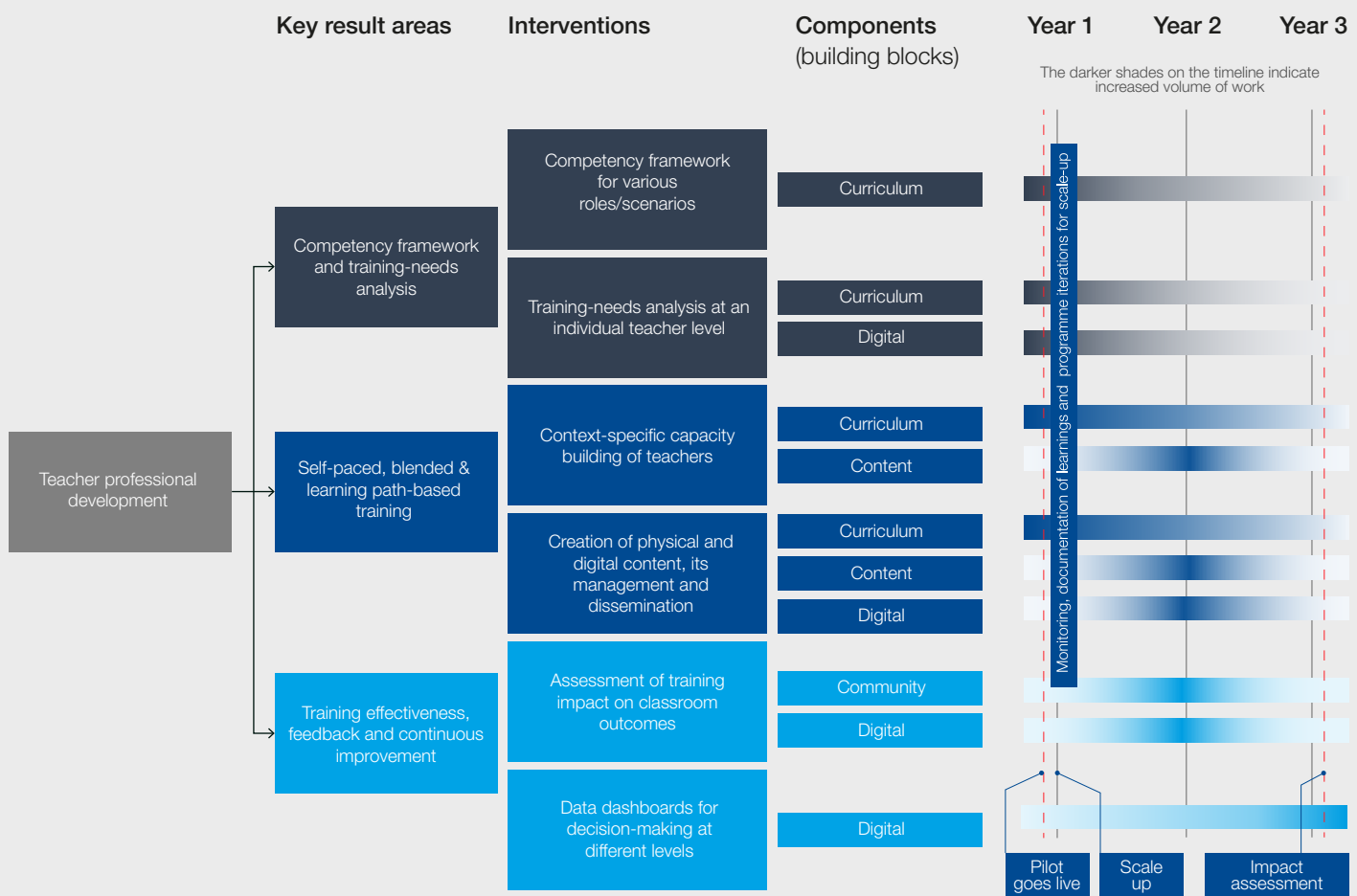
Source: Working group discussions.

Figure 16 depicts the initiatives centered on FLN. The salient features are outlined below.

- The thrust of the FLN-centric pilot is on developing an appropriate environment that can involve parents and Anganwadi workers (AWWs) in the emerging responsibility of ensuring FLN. This could involve multiple activities such as:
 - Supporting parents with learning content such as videos and worksheets.
 - Activities delivered through chatbots.
 - Scheduling tasks and timetables.
 - Establishing parents' communities for peer support.
 - Periodic SMS/phone calls to update parents on children's progress.
- The second major pillar of FLN is developing content that can be easily understood by the parents and AWWs who generally have low literacy skills. This could involve:
 - Curriculum-mapped, bite-sized content in the form of read-aloud stories, videos, flip-books, and radio and TV episodes.
 - Digital libraries.
 - Interactive, read-along content.
 - Character-based stories utilized in classrooms or at home.
- The third component involves monitoring the initiative. Activity-based (drag-and-drop, matching, gamified, etc.) assessments could track the child's learning levels, remediate gaps and generate data insights for teachers, parents and school administrations.

6.4 TPD-centric interventions

FIGURE 17 TPD-centric interventions



Source: Working group discussions.

Note *As discussed in Section 3.2, developing a career growth mindset and incentivizing teachers is an important ingredient. Implementation of this objective is beyond the scope of KINDLE.

Figure 17 depicts the initiative centered around TPD. The salient features are outlined below:

- The thrust would be on involving teachers in curriculum design and delivery of TPD programmes.
- Development of a TPD competency framework and testing it in the field with teachers would help develop learning pathways over a period of time. The data generated could be used to

recognize the probable learning trajectory for each teacher as per their context and need.

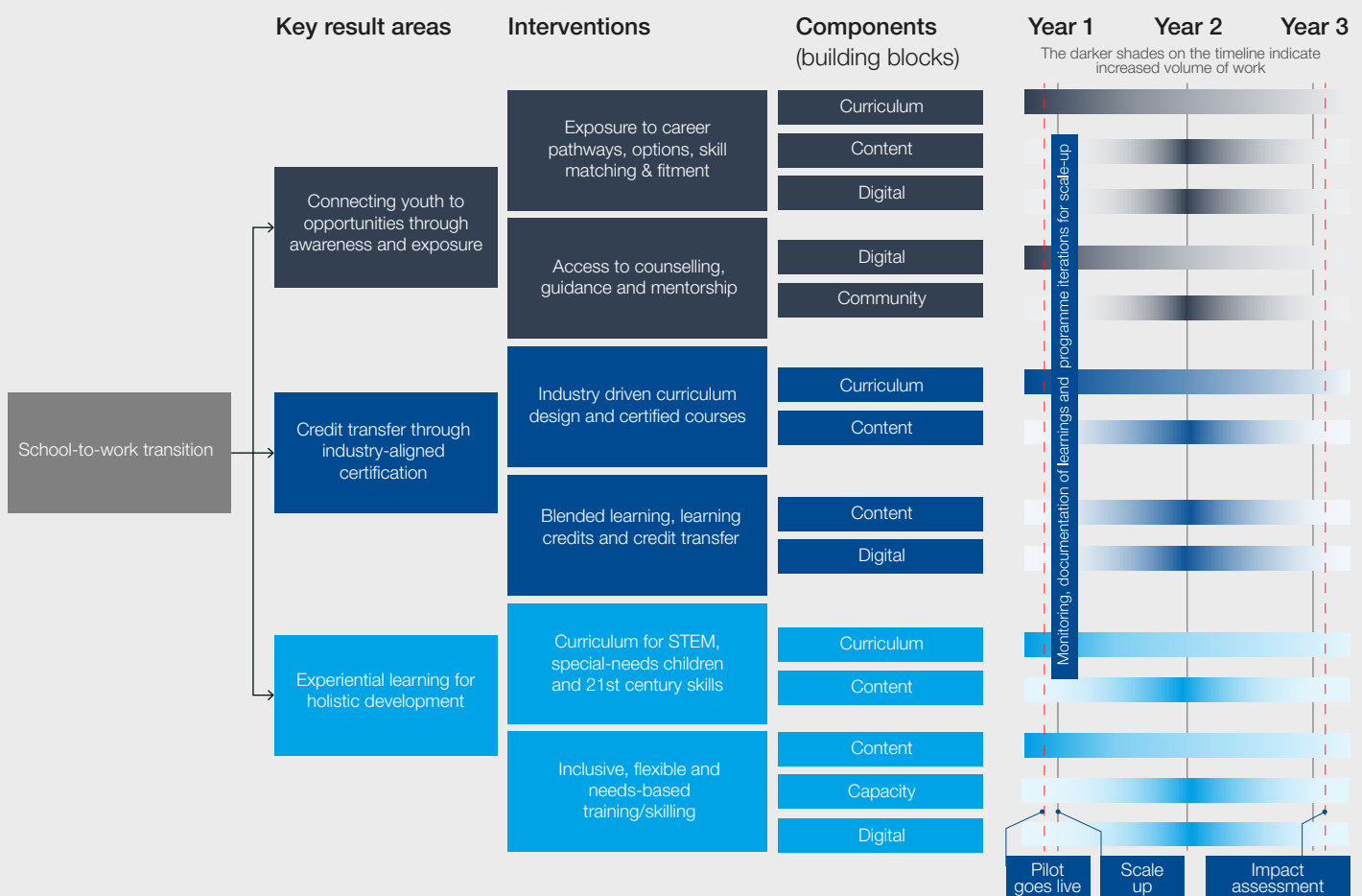
- Performance indicators would be developed for each level and data collected for mutual accountability.
- Data analysis and decision-making at all levels would make modifications possible to attain optimum outcomes.

6.5 S2W transition interventions

Figure 18 depicts the initiatives centered on the school-to-work transition. Its salient features are outlined below.

- i. The aim of the school-to-work pilot is on enabling the youth to discern the various opportunities for work and make the right choices for their skill development. The key enabler can be a single-window labour management information system (LMIS) for employers and students to identify the best opportunities. It would be equipped with a machine learning-based data verification process, enabling hassle-free onboarding of students.
- ii. As in any other educational theme, the focus should be on developing and disseminating immersive content for skill development. AR/VR/MR and 3D printing can be used to create content.
- iii. The strategy should be based on a blended training model that includes both online and offline delivery, with features such as digital course delivery and AR/VR-based practical training and assessment. Through a learning management system (LMS), students could access reading material 24x7, learn at their own pace and complete topic-wise tests at a convenient time. The LMS would include the latest pedagogical tools such as gamified learning, online assessment and collaborative learning. Teachers and parents could track students' real-time progress and evaluate them with the help of in-built statistical tools.
- iv. Exposing the students to 21st century skills is crucial. This could be done with courses in computer science, robotics, aerospace, data science, cloud computing, etc. The course delivery would be online, equipped with features such as adaptive learning, self-assessment and collaborative learning. AR/VR technologies would assist in providing experiential learning.

FIGURE 18 School-to-work interventions



Source: Working group discussions.

6.6 Measuring impact

The following table provides impact indicators within each of the identified priority areas. Pilots must be aligned with the priorities of the state concerned.

TABLE 11 Impact metrics

Key responsibility areas	Key performance indicators	Impact metrics
Foundational literacy and numeracy		
Supportive home learning environment	Number of parents registered	1. Enhancement in % of children enrolled in FLN compared to baseline % 2. Enhancement in % of children passing FLN criteria compared to baseline %
	% of parents who accessed x units of content	
Contextualized content	Content coverage of x% of curriculum per subject per grade	
	Number of videos watched for x seconds	
Smart progress reports	% of learning gaps remediated	
	Number of report cards downloaded	
Teachers' professional development		
Competency framework and training-needs analysis	% of teachers trained on identified needs	3. Improvement in teacher competencies (to be quantified and measured) 4. Enhancement in % score of students taught by trained teachers compared to students of teachers not trained
	Number of teachers ranked high on competencies	
Self-paced blended learning	Number of courses completed	
	% of drop-outs from self-paced learning over number of months	
Feedback and evaluation	Number of feedback calls/sessions per teacher per year	
	Number of classroom observations done	
School-to-work transition		
Awareness and exposure to opportunities	% of students selected for internships and related opportunities	5. % increase in student placements 6. Improvement in skills compared to baseline (to be quantified and measured)
	Number of industries/enterprises penetrated per year	
Credit transferability and certifications	Number of certified skilled workforce produced	
	% of student workforce hired with skills mapped to job requirements	
Future skills programmes	Uptake % of future skill programmes	
	% increase in employability rate	

7

Implementation framework

Successful implementation combines digital solutions with physical interventions. Fourth Industrial Revolution technologies can be used effectively where a core digital foundation has been established.



7.1 Implementation methodology

“ A combination of interventions is likely to produce more impact than a point solution that addresses a specific issue. Successful implementations combine digital solutions with physical interventions. Fourth Industrial Revolution technologies can be used effectively where a core digital foundation has been established.

Each KINDLE thematic area involves challenges and issues that require a wide range of interventions – physical, digital and phygital (physical and digital). A strategic “think big, start small, scale fast” approach is likely to produce impact within a discernible period. This strategy is in line with the typical four-stage methodology that most initiatives of the Centre for the Fourth Industrial Revolution, India, follow. The four stages are (i) gap analysis and opportunity mapping, (ii) framework development, (iii) prototyping/piloting, and (iv) scaling.

Prioritization for piloting

The key interventions recommended in the previous chapter must be validated for feasibility and potential impact by undertaking pilot projects. The interventions must be prioritized so as to produce the maximum impact quickly and in resource-constrained environments.

To this end, the working groups have mapped the interventions for viability and impact. Viability has been defined by technology innovation, ease of implementation, financial viability, acceptability and regulatory conformance. Impact has been defined as benefit to stakeholders, scalability, inclusivity and sustainability.

The interventions fall into four categories:

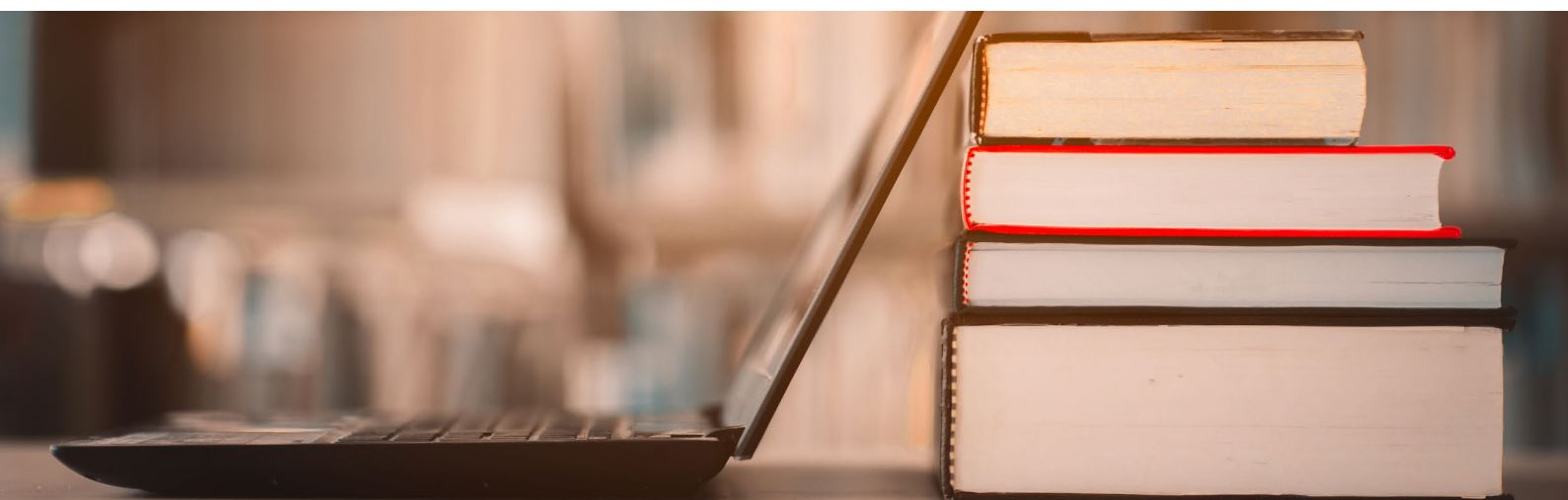
- i. **Game changers** (high viability and high impact): These can cause a transformative shift in educational outcomes.
- ii. **Easy wins** (high viability but low impact): These can be quickly scaled due to ease of implementation.
- iii. **Incremental interventions** (low viability and low impact): These can be carried out in conjunction with other initiatives. These are easy to implement but have low viability.

- iv. **Long-term interventions** (low viability and high impact): These are difficult to initiate but reap significant returns if implemented successfully. Most of these involve policy changes.

Structure of implementation framework

As part of the landscape survey, the working groups have examined over 50 relevant solutions. The following learnings have emerged, in terms of what has worked and what has not, and what is required for scaling the solutions and making them sustainable. These learnings, summarized below, provide critical inputs for designing the implementation framework.

- a. A combination of interventions is likely to produce more impact than a point solution that addresses a specific issue.
- b. Successful implementations combine digital solutions with physical interventions.
- c. Fourth Industrial Revolution technologies can be used effectively where a core digital foundation has been established.
- d. Connectivity is critical to most solutions and hence commands the highest priority.
- e. Technological scalability and interoperability require that all the digital solutions conform to the principles and standards laid down by NDEAR.³⁷
- f. Sustainability considerations indicate strongly that a multistakeholder approach be adopted in the design of pilots and their scaling.
- g. A common minimum requirement, like a foundation, is a must for implementation of pilots around various themes.



Leveraging NDEAR & DIKSHA

The NDEAR programme has made significant progress in establishing a framework for digital education at the national level. Adoption of the DIKSHA platform has grown exponentially in most states. These initiatives must be utilized to the extent that they are relevant to the core themes of KINDLE.

NDEAR has been conceptualized as a set of standards, principles and building blocks. These should be adopted in toto in the design and implementation of KINDLE pilots. Table 12 gives a synoptic view of the NDEAR components relevant to the KINDLE initiative. These are shown in two distinct categories, namely, **core building blocks**

that go into the KINDLE foundational layer and **supporting building blocks** that go into the KINDLE thematic layers.

As Table 12 shows, 22 of the 36 components of NDEAR are relevant to KINDLE. Any implementation efforts relating to KINDLE must, therefore, keep a close eye on the developments on the NDEAR front and synchronize with/adopt the same, with suitable modifications.

While many components and features of DIKSHA are relevant to KINDLE, of particular interest are energized textbooks, VidyaDaan (a call to the nation to contribute e-learning resources), NISHTHA and PM eVidya.

TABLE 12 Building blocks of NDEAR relevant to KINDLE

NDEAR components that support KINDLE foundational layer	NDEAR components that support KINDLE thematic layers			
	FLN	TPD	School-to-work transition	Connecting the unconnected
Federated identities	Content	Content	Credentialling & certification	Open AI services
– Students	– Contribution & curation	– Contribution & curation	Do-and-practice products & tools	Education cloud
– Teachers	– Taxonomy	– Taxonomy	Mentoring	Hardware for the open school
– Educational institutions	– Localization	– Localization	Counselling	Messaging services for interactions within educational domains and across learning and administration blocks
Reference data	– Discoverability			Audio/video conferencing
– Master data	– Personalization			
– Directories				
– Registries		Credentialling & certification		
Telemetry & analytics				
NDEAR sandbox				

“ The KINDLE implementation model should have adequate flexibility so that all operational decisions can be taken at the state or district level. The pilot should preferably be funded through/ by a corporate social responsibility (CSR) initiative and supplemented by the state’s budget to fill critical gaps.

Pilot design

The pilots must conform with the following principles:

- a. A pilot must be implemented in multiple blocks in multiple districts in a state, to take account of diversity.
- b. The state should be the eventual target geography of the post-pilot rollout. The pilot should be designed keeping this in view.
- c. Pilots should be designed by the state government, or a multistakeholder consortium led by it.
- d. The duration of the pilot should be two-three years; the rollout should be planned only thereafter.
- e. The KINDLE implementation model should have adequate flexibility so that all operational decisions can be taken at the state or district level.
- f. The pilot should preferably be funded through/ by a corporate social responsibility (CSR) initiative and supplemented by the state’s budget to fill critical gaps.
- g. The pilot should build on the work already done in the relevant geography.
- h. The roles and responsibilities of multiple parties including the public and private sectors must be clearly defined in the form a memorandum of understanding (MoU).
- i. The scope should include an essential component for building capacities at the state and district levels in data systems.
- j. An effort should be made to build a reference model during the rollout phase such that it could be showcased to other states for adoption.
- k. Multiple ways of involving the community must be included in the pilot design.

Implementing KINDLE ...as a stakeholder in the education ecosystem

The Education 4.0 India vision is best realized by adopting a multistakeholder approach based on public-private cooperation models. Considering

this, the following are the proposed ways in which some of the key stakeholders can engage with KINDLE:

TABLE 13

How stakeholders can engage with KINDLE

Stakeholder	How they can engage (indicative)
Government of India	1. Formulate appropriate policies on PPP, innovation, standard-setting 2. Establish core building blocks of NDEAR, in addition to the five proposed by KINDLE 3. Dovetail KINDLE with national programmes like NIPUN and DESH e-stack
State governments	1. Co-design and implement pilots in KINDLE themes, in a multistakeholder mode 2. Incentivize teachers with policies on career advancement linked to performance, for instance in foundational literacy and numeracy
Educational institutions	1. Participate actively in the implementation of KINDLE recommendations 2. Provide regular feedback and participate in impact assessment to improve the programme for scaling
Edtech companies and technology providers	1. Design innovative solutions that meet the requirements of KINDLE recommendations, or modify their existing solutions to support the interventions 2. Co-design the building blocks and content aligned to the interventions and goals

Conclusion

As a socially relevant initiative, Education 4.0 India focuses on themes that the central and state governments in India are currently addressing. The impact can be tremendous – from making education more accessible and inclusive, to reducing dropout rates, to improving learning outcomes by using more adaptive learning systems and community engagement.

The interventions recommended in this report call for a coordinated, multistakeholder effort designed and undertaken in a sustainable manner. It suggests the following steps be taken on priority:

1. **Communication:** The Centre for the Fourth Industrial Revolution, India, and UNICEF will jointly share this insight report with a wide range of actors in India's school education ecosystem, including central and state governments, public sector enterprises, private education groups, NGOs and foundations. A series of national- and state-level workshops can be conducted

over a three-month period to disseminate the intent of the initiative and to elicit interest.

2. **Partnership:** The interests and leads arising from the previous step shall be followed with in-depth, one-to-one discussions with organizations interested to partner for implementing the KINDLE programme. The potential partners should bring credible expertise, experience and resources for supporting pilots and roll-out as needed.
3. **Promotion:** Aligned with the Centre for the Fourth Industrial Revolution philosophy to “think big, start small, scale fast”, the immediate next step would be to define and scope at least three pilots on KINDLE themes, in partnership with the institutions identified in the previous step.
4. **Institutionalization:** The organizations, in parallel with the above steps, will work towards creating an appropriate institutional structure to carry forward the Education 4.0 India mission.

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Abbreviations

AI-ML	Artificial intelligence-machine learning
App	Application
AR	Augmented reality
AWW	Anganwadi worker
BI	Business intelligence
CBO	Community-based organization
CBSE	Central Board of Secondary Education
CDO	Chief diversity officer
CICSE	Council for the Indian School Certificate Examinations
CPD	Continuous professional development
CWSN	Children with special needs
DIET	District Institute of Education and Training
DIKSHA	Digital Infrastructure for Knowledge Sharing
DESH	Digital Ecosystem for Skilling and Livelihood
ECCE	Early childhood care and education
Edtech	Education technology
EFA	Education for All
EY	Ernst & Young
FLN	Foundational literacy and numeracy
GP	Gram panchayat
GDP	Gross domestic product
HTML	Hypertext markup language
ICT	Information and communications technology
IDE	Independent development editor
IP	Intellectual property
ITI	Industrial Training Institute
K12	Kindergarten through 12th grade
KINDLE	Knowledge and Information Network for Digital Learning and Education
LAHI	Lend-A-Hand
LMS	Learning management system
LMIS	Labour management information system
MCB	Micro-concept booklets
MHRD	Ministry of Human Resource Development
MOE	Ministry of Education
MoU	Memorandum of understanding
MOOC	Massive open online course
MSMEs	Micro, small and medium-sized enterprises
MWCD	Ministry of Women and Child Development
NCERT	National Council of Educational Research and Training
NDEAR	National Digital Educational Architecture
NEP 2020	National Education Policy 2020
NETF	National Educational Technology Forum
NGO	Non-governmental organization
NIPUN	National Initiative for Proficiency in +cvf and Numeracy
NISHTHA	National Initiative for School Heads' and Teachers' Holistic Advancement

NLP	Natural language processing
NSQF	National Skills Qualification Framework
PEEO	Panchayat elementary education officers
Phygital	Physical and digital
PI	Performance indicators
PMU	Project management unit
PPP	Public-private partnership
QR	Quick response
QoS	Quality of service
RAP	Remote access point
RSCERT	Rajasthan State Council of Educational Research and Training
S2W	School to work
SCERT	State Council of Educational Research and Training
SLM	Self-learning material
SMS	Short message service
SSO	Single sign-on
STEM	Science, technology, engineering and mathematics
STEAM	Science, technology, engineering, the arts and mathematics
SWAYAM	Study Webs of Active Learning for Young Aspiring Minds
TPD	Teacher professional development
UDISE	Unified District Information System for Education
UN	United Nations
UTs	Union territories
UNDP	United Nations Development Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNICEF	United Nations Children's Fund
VR	Virtual reality
WAY	World Around You

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